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[OFFICIAL NOTICE.]

Eighteenth Annual Meeting of the American Gas Light Association.

EXTRACT FROM THE CONSTITUTION:—Sec. 12. *Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least ten days prior to the meeting at which the application is acted on.*

OFFICE OF THE SECRETARY,
LAWRENCE, MASS., Sept. 15, 1890.

To the Members of the Association: Gentlemen—The Eighteenth Annual Meeting of the Association will be held at Savannah, on Oct. 15, 16, and 17. The headquarters will be at the De Soto. The members will be called to order on the morning of Wednesday, Oct. 15, at 9.15 o'clock, by the President, Emerson McMillin, Esq., when the Association will be welcomed to the city of Savannah by his Honor the Mayor.

We now have the following papers promised, so that we are guaranteed a good literary programme:

"The Extension of the Use of Gas for Purposes other than Illumination," by E. G. Pratt, Des Moines, Ia.

"The Mismanagement of Gas Works," by E. G. Cowdery, Milwaukee, Wis.

"Gas Coals of the United States," by H. C. Adams, Phila., Pa.

"The Practical Efficiency of an Illuminating Water Gas Setting," by A. G. Glasgow, Philadelphia, Pa.

"Inclined Retorts," by Frederic Egner, St. Louis, Mo.

"The Gas Engineer and his Pencil," by F. H. Shelton, Phila., Pa.

"Purification of Gas," by A. E. Forstall, Chicago, Ills.

"Suggestions of Methods and Systems for Recording the Histories and Accounts of Gas Light Companies," by Wm. P. Fodell, Phila., Pa.

We also expect a paper on the Pintsch Lighting System.

I would repeat my invitation of former years for members to send along in advance their puzzles for the question-box.

The meetings of the Association will be held in the banquet hall of the De Soto, on the first floor directly over the dining room, not on the top floor, as previously stated by me through error. It will be an agreeable feature of the convention to have our meetings in the hotel selected as our headquarters.

I want to call the attention of the members to the bulletin board which will be placed in the rotunda of the hotel. Notices in regard to the meeting will be posted thereon, and it will be well for the members to consult the same from time to time.

As much valuable time is usually lost in calling the roll of the Association, and as we then have but an inaccurate list of the members present, it is proposed this year to have the members hand in their names to an attendant as they enter the meeting hall for the first time; of course, members will only be expected to give their names once.

A new feature of our meeting will be the welcome which will be extended to the members by His Honor the Mayor and the members of the City Government. In order that the time of the Association usually allotted to business be not taken up by this courtesy, it has been arranged that the Association come to order for the purpose of hearing the Mayor at 9.15 A.M. We will then be ready to take up regular business at 9.30 o'clock.

I would remind those members who have not already sent checks for their dues, that the Secretary will take it as a favor if they will give this matter their attention, as it will help him greatly to have the collection of the yearly bills disposed of before the meeting.

As previously announced, the rate given us at the De Soto is $3.50 per day, board included, and a discount will be made from this figure if the attendance is large; it is hardly necessary to add that bathrooms and parlors will be charged for extra. It is earnestly hoped that all the members will make the De Soto their headquarters, as they will thus help in obtaining a low rate for the members.

Matter of transportation is dealt with in another circular.

From letters received by the Secretary it appears that we are to have a large gathering at Savannah, and he is very glad that it is to be so, because there is every reason to hope that the meeting will be both profitable and pleasant. The citizens of Savannah are looking forward to the meeting with pleasurable anticipations; and as they are so ready to extend to us a hearty welcome, it is but just courtesy that there should be a large number present to acknowledge their kind attention. The local papers have been more than ordinarily attentive in keeping the matter of the meeting before the people, and in this connection special mention should be made of J. H. Estell, the proprietor of the *Morning News*, who, by the by, was the second newspaper man in this country to use the new large cylinder press.

It is hoped that not only will we have a large number of members present at Savannah, but also that they will bring their ladies, as special arrangements are being made for their entertainment; a Committee of Reception has been selected from Savannah's fair ladies to assist the

United Gas Improvement Company and the Mutual Gas Light Company in their entertainment, and they will devote themselves especially to the care of the ladies. Carriage drives will be tendered the ladies, who will thus have the opportunity of visiting the many attractions of Savannah; visits to Telfair Art Gallery, the Historical Society Building, and Bonaventure will be among the attractions offered. It is also expected that an informal hop will be the programme for one of the evenings. Of course, it will be informal, so the members and ladies will be free to spend as much or as little time at the dance as they desire. *En passant* I would remark that probably this announcement of a hop will cause our young members—and possibly the older ones also—to shake out their dress suits and arrange to take them along with them to the Sunny South; I also presume that the ladies will be glad of an inkling of this attraction in order that they may have the opportunity to come prepared.

On Thursday evening the Association will be tendered a banquet by the United Gas Improvement Company and the Mutual Gas Light Company, of Savannah; the large dining hall of the hotel will be the scene of the festivities, and there will be present in addition to the members of the Association, the Mayor and other officials of the city and a number of other prominent citizens.

On the last day of the meeting the members and their ladies will be tendered an excursion on the river, when we will have as our hosts the same Companies to whose courtesy we will have been indebted for the banquet of the previous evening, and for the many entertainments provided for the ladies.

Transportation.

September 20, 1890.

Again let me impress upon the members that Savannah is within easy reach of most of our members. Leaving Boston 7 o'clock Sunday night, Savannah would be reached by 6.44 Tuesday morning. Getting away from New York Sunday, at midnight, the trip would end Tuesday morning at 6.44. From Chicago, one route is over Illinois Central to Cincinnati, thence by Queen and Crescent, Western and Atlantic and Georgia Central; time, 39 hours. Time from Cincinnati, 34 hours. From St. Louis, via Louisville and Nashville, and Nashville, Cincinnati and St. Louis and Western and Atlantic and Georgia Central; time, 34 hours. Or those living in the vicinity of New York or Boston who prefer an ocean trip can take one of the Ocean Steamship Company's vessels from New York or Boston, and land right at the city, the trip taking from 48 to 55 hours. The rate by this route, including meals and berth in stateroom—first-class—is, from New York, $15, or $25 for the round trip. From Boston the rate is $17 one way, or $29 for the round trip. Those desiring to secure these special rates must obtain a proper certificate from me.

I have secured from the following Passenger Associations the usual concession in railroad rates, namely: The Southern Passenger Association, composed of the following companies: Alabama Great Southern; Atlantic Coast Line; Atlanta and West Point; Brunswick and Western; Charleston and Savannah; Central Railroad of Georgia; Cincinnati, New Orleans and Texas Pacific; East Tenn., West Virginia and Georgia; Georgia Railroad; Georgia Pacific; Illinois Central (lines south of the Ohio river); Jacksonville, Tampa and Key West; Louisville and Nashville (lines south of the Ohio river); Louisville, New Orleans and Texas; Mississippi and Tennessee; Mobile and Ohio (lines south of the Ohio river); Memphis and Charleston; Nashville, Chatta. and St. Louis; New Orleans and Northeastern; Norfolk and Western; Pennsylvania (lines south of Washington); Port Royal and Augusta; Raleigh and Gaston; Richmond and Allegheny; Richmond and Danville; Richmond, Frederick and Potomac; Rome Railroad; Savannah, Florida and Western; Seaboard and Roanoke; Shenandoah Valley (lines south of the Potomac river); South Carolina Railway; Vicksburg and Meridian; Western and Atlantic; Western Railway, of Alabama.

Trunk Line Association, composed of the following railroads: Grand Trunk; N. Y. C. & H. R.; West Shore; N. Y., O. & W.; N. Y., L. E. & W.; D., L. & W.; Lehigh Valley; Central Railroad of N. J.; Phila. & Reading; Pennsylvania; Bal. & Ohio; Ches. & Ohio Railroad.

Central Traffic Association: The New York and Boston lines, composed of the various lines between the two places named.

The territory covered by the Trunk Line Association is as follows: From Niagara Falls; Buffalo; Salamanca, N. Y.; Pittsburgh, Pa.; Bellaire, O.; Wheeling; Parkersburg and Charleston, W. Va.; and points east thereof, except New England.

The Central Traffic Association covers the following ground: Bounded on the east by Pittsburgh, Salamanca, Buffalo and Toronto; on the north by the line of and including points on the Grand Trunk Railway, from Toronto to Port Huron, thence via Lakes Huron and Michigan to the north line of Cook county, Ills.; on the west by the west line of Cook county and the Illinois and Mississippi rivers to Cairo, including the Burlington, Keokuk, Quincy, Hannibal and St. Louis; and on the south by the Ohio river, but including points on either side of that river, while the territory under the Southern Association is south of the territories above mentioned.

The usual concession in railroad rates has been granted, namely: one-third off on the round trip. That is, members will pay full fare going, obtain a certificate from the ticket agent from whom they purchase their tickets, and, upon presentation of this certificate at Savannah (after being duly endorsed by me), they can obtain the return ticket at one third the usual rate. To illustrate: The regular fare from Chicago to Savannah is $23.30, and a member starting from the former city will pay that amount for a ticket to Savannah. At the time of purchasing his ticket, he obtains the necessary certificate from the agent; he has that endorsed by me at Savannah; then, on presentation of the same to the ticket agent at Savannah, he can procure a return ticket for $7.77. The regular fare from St. Louis is $20.55; from Cincinnati, $19.30; from Boston, $29.75.

Parties starting from New York or Boston can obtain their tickets from the agents of the Atlantic Coast Line or Pennsylvania Railroad.

The offices of the Atlantic Coast Line are: New York, 229 Broadway; Boston, 228 Washington street; Philadelphia, 33 South 3d street; Baltimore, 233 East German street.

The following extracts from the regulations of the railroads are cited for the information of the members:

First. Each person desiring the excursion rate must purchase a first-class ticket (either limited or unlimited) to the place of meeting, for which he will pay the regular fare, and upon request the ticket agent will issue a printed certificate of purchase of the standard form as shown in this circular.

Second. If through tickets cannot be procured at the starting point, parties will purchase to the most convenient point where such through tickets can be obtained, and repurchase through to place of meeting, requesting a certificate from the ticket agent at the point where repurchase is made.

Third. Tickets for the return journey will be sold by the ticket agents at the place of meeting at one-third the highest limited fare, only to those holding certificates signed by the ticket agent at point where through ticket to place of meeting was purchased, and countersigned by signature written in ink by the Secretary or Clerk of the Association, certifying that the holder has been in regular attendance at the meeting.

Important.

☞ Be sure to obtain your railroad certificate before starting.

☞ Be sure to apply for railroad ticket at least 30 minutes before train time.

☞ Be sure to have the Secretary indorse your certificate at Savannah.

Members desiring to go by boat from New York or Boston can take steamer from either of the two cities named direct to Savannah.

The Ocean Steamship Company's vessels sail from pier 35, N. R., New York. The Chattahoochee (Capt. Daggett) sails Friday, Oct. 10. Nacoochee (Capt. Smith), Saturday, Oct. 11. City of Birmingham (Capt. Burg), Monday, Oct. 13. Sailing time, 3 P.M.

Time from New York, about 48 to 55 hours. Fare one way, $15; round trip, $25, including meals and berth in stateroom.

From Boston, the vessel leaves Lewis Wharf. City of Macon (Capt. Lewis), Saturday, October 11, 3 P.M.

Yours truly, C. J. R. Humphreys, Sec'y.

BRIEFLY TOLD.

The Savannah Convention.—At the present writing it seems as if the Savannah convention of the American Gas Light Association will be notable for a large attendance, in that the general cry all along the line is, "Meet you at Savannah." The Secretary is in almost daily receipt of applications for membership blanks, so we are also assured that the roll is to be increased in goodly fashion. Whether by land or by sea, as the members elect to make the journey, one and all may be assured of a good time, and a profitable one, as the sequence of their trip.

Off to Europe.—We are at once pained and pleased to make the announcement that the Association will miss two which it would be pleased to welcome at its gathering next week; for Fred. W. Floyd, of Messrs. James Floyd & Sons, of this city, and Mr. D. R. Daly, Superintendent for Messrs. J. H. Gautier & Co., of Jersey City, sailed last Saturday for Europe, where they will spend at least two months. We are "pained" to know that they are not to be with us, but are "pleased" over the fact that the cause of their absence is just what it is.

Staggered Already.—The City Council, of Nashville, Tenn., not long since instructed the Board of Public Works to determine what would be the probable cost of constructing a gas plant, of a capacity fitted to meet the gaseous wants of the city and its residents. The matter of computing the necessary expenditure was intrusted to City Engineer Jowett, who for the past 30 days has confined himself to the mapping out and expense of the piping system alone. He finds that 130 miles of main, of all sizes, would be absolutely necessary for the effective working of the plant, and that the expense thereof, complete, would be $441,265.50. And the works proper, or the ground whereon they are to stand still to be heard from! Whew! How Mr. Prichitt, of the Nashville Company, must smile over the first returns!

Electric Lighting Many Times Superior to Gas.

[A paper read by M. Paul Hoho, at a meeting of the Belgian Society of Electricians.]

At a conference which took place a short time since in connection with the general assembly of the Union of Engineers graduated at the University of Louvain, I had occasion to make a comparison between certain figures relative to the yield of an electric incandescent lamp and a jet of gas. I was greatly surprised at the astonishment which my conclusions evoked, even amongst electricians; and I was induced thereby to repeat my calculations in our Society, with a view to raising a discussion so as to accentuate the affirmative character of the conclusions which might result. In any case it is well to proclaim aloud and to reiterate figures which ought certainly to find a place on the leading page of every engineer's pocket book. The matter is one of extreme simplicity, and, frankly, I ought to apologize to you for introducing one so elementary.

The entire question reduces itself to this: What amount of energy is required by an incandescent lamp on the one hand, and a gas jet on the other, in order to produce an equal amount of light—for example, an amount equivalent to 16 candles?

Allow me to make a slight digression for the purpose of assisting somewhat in preparing gas for the sentence which is about to be pronounced upon it by figures which admit of no appeal. The action of the incandescent lamp is based upon the fact that the energy of the electric current in traversing its filament is transformed, by reason of the resistance offered by the latter, into calorific energy, which emanates from the filament in the form of calorific rays. But, as you are aware, a solid body if placed in a certain temperature becomes incandescent—that is, a part of the calorific rays becomes luminous. For the complete utilization of this property it would be necessary to attain to such a temperature that the proportion of the luminous rays to the total radiation is the maximum. Unfortunately, the physical constitution of the filament, as we actually possess it, does not admit of its being placed above a certain temperature; and we are compelled, therefore, to moderate the action of the electricity in the lamps. The incandescent lamp, as far as it goes, is consequently very far from realizing our ideal; and in order to bring a out its perfect action upon this principle, electricity is compelled to await the progress of chemistry, which I hope will one day give us a body upon which electricity will be able to exercise its action without restraint. I will not expatiate upon what may be reasonably expected by electricity upon this head, but will base my calculations upon results as they have been actually obtained.

As regards the gas jet, I would first of all remark what a singular idea was that which sought to light up the universe by means of a flame. A flame, as you are aware, is essentially composed of gaseous elements, in which is found a comparatively slender quantity of solid particles. Now, we learn by physical science that from gas, at whatever temperature it may be carried, emanates very little or no light. All its rays are calorific: and the light which emanates from the flame is exclusively composed of solid particles, notably carbon. Is it possible to imagine a more irrational method of lighting? You may attempt to excuse it by saying that it has for a long time been the only one we knew. I admit the excuse, and even that it is a serious one; but you must also confess that it is the only one.

A priori, we are in a position to foresee the wretched result to be had from a gas jet and it only remains to compare the figures. An incandescent lamp of 16-candle power consumes at its terminals 2, 2¼, 2½, 3, to 3½ watts per candle, or 32, 36, 40, 48, to 56 watts for every 16 candles, which amounts to 3.2, 3.6, 4, 4 8, 5.6 kilogrammeters per second for every 16 candles. On the other hand, a 16-candle power gas jet consumes 180 liters and more per hour. Now, a cubic meter of gas, by its combustion, gives out 6,000 calories (according to M. Fresca's calculation), and 180 liters will give out $6{,}000 \times \frac{180}{1{,}090} = 1{,}080$ calories; 1,080 calories $= 1{,}080 \times 424 = 457{,}920$ kilogrammeters, which a gas jet consumes per hour—that is, $\frac{457{,}920}{3600} = 127.20$ kilogrammeters per second.

It only remains now to compare this consumption of energy with that of an incandescent lamp, as set out below;

$$\frac{127.20 \text{ kilogrammeters}}{3.2} = 39.75;$$

$$\frac{127.20 \text{ kilogrammeters}}{3.6} = 35.33;$$

$$\frac{127.20 \text{ kilogrammeters}}{4} = 31.80;$$

$$\frac{127.20 \text{ kilogrammeters}}{5.6} = 22.71;$$

From these I conclude that, in order to produce a luminous intensity of 16 candles, a gas jet consumes 22.71 to 39.75 times more energy than an incandescent electric lamp, counting the latter at 2 to 3½ watts per candle, and the consumption of gas at 180 liters per hour. I conclude, further, that the incandescent lamp, supplies an illumination absolutely 22 to 40 times that of a gas jet. That is all I had to prove; and I could content myself with pointing out that, to destroy these conclusions, it will be necessary to invalidate the preceding figures, which is, I repeat, impossible. However, as I foresee myself being answered in the eternal phrase of "theory and practice," I will dwell a little longer upon the matter than it really demands.

In the above conclusion I have specified all that the figures teach. They tell us nothing more; but, above all, nothing less. We therefore have it that the incandescent lamp constitutes a transformer for the production of luminous energy 22 to 40 times more perfect than the gas jet, comparing the two individually without regard to the production of energy by the one or of gas by the other. This is the first thing to be established.

Next, as regards the production of electric energy and the production of gas. Energy is present in nature under various forms; under that of chemical energy in carbon and other bodies, as calorific energy, as the energy of gravitation and of masses in movement—for example, the fall and flow of water. Gas can only be obtained from coal, and in certain cases where it is already existent in nature; whilst it cannot be drawn from energy which exists in other forms, unless in the most roundabout and impossible way. Electric energy, on the contrary, may be obtained by the transformation of energy existing in any form with various results. Thus coal may be transformed into electric energy by a series of transformations yielding a feeble result, which is successively diminished by each transformation. The mechanical energy which may be employed upon a shaft moved by a fall of water may be transformed into electric energy and afford results unknown in any other industry—85, 90, and even 93 per cent., for instance. Therefore, in comparing electricity with gas, it would be absolutely unreasonable to deal with energy as existing under one form only.

If gas, for the sake of a cause which is otherwise indefensible, demands that the comparison be made from the standpoint of the energy of coal compared with that of gas, electricity will not shrink from the comparison. But should electricity in its turn call for a comparison with other forms of energy, the protests of the advocates of gas would only be equalled by the disastrous results to their clients. However, for the production of light, it suffices on principle to have a suitable transformation of energy, nothing but energy; and this as much as possible free from carbon fumes and from the emanations of carbonic acid and other similar products whose influence is little beneficial. It is true that coal is to be found in large quantity in nature, and that in this country, as a rule, it offers the most economical and convenient form of energy for our needs. But we are not merely arguing the case of Brussels; and without admitting the hypothesis that some day or other we shall have to make use of the Niagara Falls, we have still in this country waterfalls and flows which could be easily utilized, and which have, in fact, been so very frequently.

We by no means decline to institute a comparison with gas on the standpoint of coal or of gas even; but first let us point out the insufficiency and exclusiveness of the comparison. Thus 40 kilos. of coal furnish a maximum of 3,000 liters of gas, or a quantity sufficient to feed 10 jets of 16-candle power during one hour and forty minutes. To produce electric energy from coal we are obliged in the first place to transform, by a series of transformations, the energy of coal into mechanical energy, and next into electric energy. With the aid of a good condensing engine 10 kilos. of coal will furnish 8-horse power hours upon the shaft, by means of which the dynamo electric machine will furnish 8-horse power hours × 75 kg. × 9.8 watts × 80 per cent. = 4,800 watt hours, or the amount of energy necessary for supplying 10 incandescent 16-candle lamps during 8½ to 15 hours. Result in favor of electricity:

$$\frac{8\frac{1}{2} \text{ to } 15}{1\frac{1}{8}} = \frac{5\frac{1}{2} \text{ to } 9}{1}$$

And, moreover, the first transformations of the energy, up to the driving shaft, before electricity had come into play had only furnished a total rendering of 10 per cent.. In fact, 1 kilo. of coal gives an immediate yield of 5,000 calories = 2,120,000 kilogrammeters, whereas upon the driving shaft we have 0.8-horse power × 75 kg. × 3,600 s = 216,000 kilogrammeters, which gives a rendering of:

$$\frac{216{,}000}{2{,}120{,}000} = 0.10 = 10 \text{ per cent.}$$

Let us now make the comparison on the score of gas—that is, by employing the 3,000 liters of gas produced by 10 kilos. of coal on the one hand directly in the gas jets, and on the other for producing, by means of various transformations, electrical energy for the supply of incandescent lamps. The 3,000 liters of gas will supply, it is said, ten jets of 16-candle power during one hour and forty minutes. On the other hand, they will supply upon the driving shaft of a gas motor $\frac{3.000}{700} = 4.286$ horse power hours, by means of which the dynamo will furnish 4 286-horse power hours × 75 kg. × 9.8 watts × 80 per cent. = 2,560 watts hours, or the amount of energy required for supplying ten 16-candle incandescent lamps during 4½ to 8 hours.

Result in favor of electricity:

$$\frac{4\frac{1}{2} \text{ to } 8}{1\frac{3}{4}} = \frac{2.74 \text{ to } 4.8}{1}$$

And, moreover, the gas motor, which consumes 700 liters of gas per horse power hour, only returns 15 per cent. yield. In fact, 700 liters of gas give immediately:

$\frac{700}{1,000} \times 6,000 = 4,200$ calories $= 4,200 \times 454 = 1,780,800$ kilogrammeters; whilst on the driving shaft they gave 75 kg. × 3,600 = 270,000 kilogrammeters, or $\frac{270,000}{1,780,000} = 0.15 = 15$ per cent.

These figures point their own conclusions sufficiently clearly, precisely, explicitly and instructively to be developed by us. I have only to point out what follows as a consequence: (1) The loss which occurs in obtaining electric lighting by means of coal or gas, is not to be attributed to electricity, but to the successive transformations of energy with very slender results before electric energy is obtained. (2) Directly electricity comes into play—that is, when mechanical becomes transformed into electrical energy—the yield is enhanced to 80 per cent., as mentioned in my calculation, and may in fact reach to 85, 90 and 93 per cent. and more. (6) Therefore, in spite of the preliminary very unfavorable transformations of electricity, a total result is obtained which is notably superior to gas, as I have shown in the foregoing figures.

These will be found to gain in importance and to accentuate the advantages of electricity, if we take into consideration the following three facts: (1) The transformation of energy in general in all these forms makes continuous advances. Whilst these advances constitute an immediate advance for electric lighting, they bring with them no advantages for gas lighting. It is true that gas is in no way prejudiced by the transformations undergone by it before its utilization; but its failure consists entirely in its employment as a lighting medium. (2) The transformation of electric energy is making rapid progress. The same cannot confidently be said of gas, which, after over a hundred years' of use, finds itself already outstripped by a luminant which hardly counts an existence of ten years. (3) Electric energy is peculiarly transportable from long distances, a fact which enables it, and will enable it, to overcome local circumstances disadvantageous to its production, by enabling its production in localities where the conditions are more favorable.

The London *Journal*, in commenting on the Hoho conclusions, says: * * The paper has been reproduced by the *Electrical Review*, which journal at the same time, in a short editorial note, expressed curiosity as to the "complexion" that the technical press devoted to the gas industry would put upon M. Hoho's results. Our contemporary admitted as a possibility that the author "may have based his conclusions on false premises," and remarked that in this case they would soon be "opposed" by us. We have no objection to this comment, but think that the word "exposed" might have been more appropriate than that which actually occurs in it. The following up and exposing of electricians' false logic and misleading ways of stating facts, have been our peculiar care for some years; and, as time goes on, we do not find this task lightened, but rather the contrary. It is not for us to set up as a pattern for the electrical or any other technical journals to imitate; but we can at least claim that these columns are always open to statements from all parties, and in particular that we give every opportunity for electricians to plead their own case. Thus we reproduce M. Hoho's paper in full, for what it is worth; and it is nobody's fault but the writer's own if his statement is found after all to amount to little or nothing. He probably thinks a great deal of it himself; but he will be almost singular in this opinion.

M. Hoho is not hindered by modesty from stating his case in the strongest possible way. He believes that he has absolutely wiped gas lighting off the face of the earth, by bringing against it "figures which admit of no appeal." With a view to prepare the friends of and believers in gas for this stern sentence, M. Hoho kindly explains at the very commencement of his paper that the matter is all a question of "energy." He essays to compare the expenditure of energy in the form of light by the way of electric lighting, with that of gas lighting; and he triumphantly concludes, from his way of stating and arguing the question, that gas is simply nowhere. He is even exuberantly merry at the preposterous notion of using a gas flame as a lighting agent; and he only excuses the practice on account of ignorance of mankind, who knew no better. Try to light by means of gas flames, after physical science has demonstrated that a gas is a poor radiator, and that it only becomes luminous at all by imparting heat to solid particles occurring in it? Why, argues M. Hoho, the idea is ridiculous! He proves this by reckoning up the proportion of the potential energy of a gas jet that appears as light; and then he does the same for an incandescent electric lamp. The result is to show that in order to produce a luminous intensity of 16 candles, a gas jet consumes 22.71 to 39.75 times more energy than an incandescent electric lamp, counting the latter at 2 to 3½ Watts per candle, and the consumption of gas at 180 litres (6.3 cubic feet) per hour."

This is M. Hoho's theoretical proof; and it shows that, as a medium for converting energy into light, the incandescent electric lamp is from 22 to 40 times more efficient than a gas flame. It is a very pretty operation, and the use made by the Belgian theorist of the C. G. S. system looks very learned and convincing. Even the essayist himself, however, is afraid to linger too long on the contemplation of his result; knowing full well, as he says, that somebody would be sure to answer him before long in what he disdainfully calls "the eternal refrain of theory and practice." It is naturally very annoying to an ardent theorist to be pulled up in full career by an adverse signal (to borrow a metaphor from railway engineering), and to be told that the epoch-making run which he had fondly hoped he was indulging in was due to having dropped all his coaches and keeping full steam on a light engine. What is the good of talking about the theoretically possible, while the actual lags so lamentably behind? M. Hoho feels the point of the reproach, and hurries to show that he is not afraid of repeating the comparison between the relative efficiencies of gas and electric lamps, even when practical considerations are taken into account. In so doing, however, he first of all reduces the difference between the gas and the electric lamp from his ratio of 1 : 22 or 40, to 1 : 5½ or 9. Before he finishes, moreover, the ratio, even in his hands, comes down to 1 : 2.74 or 4.8. At this figure, however, we begin to raise our heads once more, and think of the possibility of applying a little correction to the electrician's data. While he was talking of electric lamps from 22 to 40 times better than gas lamps, it would have been idle to enquire whether the gas was taken at its fair value. To a man anticipating instant decapitation, the question, of the value of his life, in the insurance agent's sense of the term, under different conditions, would be immaterial. Similarly, while M. Hoho was condemning gas to immediate extinction as the crude provisional device of a half-civilized people, the question of the duty of different burners would be an idle one. But when the electrician deigns to confess that from a point of view which he does not debar himself from taking, there is a difference between electric lamps and gas of only as about 3 or 4 to 1 in favor of the former, it is time to inquire what sort of lamps he is talking about. He takes the duty of incandescent electric lamps at from 2 to 3½ Watts per candle, which is favorable enough in all conscience. The gas burner he values at 16-candle power for a consumption of 6.35 cubic feet per hour, or a duty of 2.36 candles per cubic foot, which is only true of the worst and cheapest burners in use anywhere for gas of average quality, even as judged by a Continental standard. Recuperative gas burners as good in their way as those incandescent lamps cited by M. Hoho, will give a duty of at least three times his figure, as the most cursory investigation would have indicated. Thus, by merely applying the first and most obvious correction to M. Hoho's calculations in their final form, we make the comparison of incandescent electric lamps with gas bear the contrary aspect to that which it assumes in his hands. This is easily done, moreover, without challenging M. Hoho's method, but merely correct a single datum.

To go back from this result to the Belgian electrician's first startling contention—which is infinitely more striking than the ultimate result after he has corrected his argument by reference to practical considerations—how is it possible to contend that the electric incandescent lamp is from 22 to 40 times more efficient a converter of energy into light than a gas flame? M. Hoho does it by regarding for his own purpose the two lighting agents as identical in character, whereas they are as widely different as any two things used for the same purpose can possibly be. Gas is merely a fraction of the components of coal, from which it is obtained by a process essentially chemical. When it is ignited in a lamp or burner for the sake of its light, this is the first and last conversion of its potential energy. We know that in this conversion a good deal

more energy appears as heat than as light, which is sometimes an advantage, and sometimes the reverse. The practical problem of varying at will the ratio of the heat to the light of a burner, or rather of concentrating the former, is what gas-lamp makers are engaged upon to-day with hopeful prospects. If M. Hoho does not believe us upon this point, he can inqure of a dozen inventors of gas lamps, who do not think they have lost all their labor. The incandescent electric lamp, however, is the last of a series of conversions of energy, beginning in the steam boiler furnace of the driving machinery. All the potential energy of the coal that is made available by the series of operations appears in the incandescent lamp, while only a part of that of the coal utilized in gas lighting is represented in the illuminating burner. Surely, therefore, the comparison should start from the coal, which is the original store of potential energy, and not from dissimilar stages in two different applications thereof.

There would be no novelty in such a comparison, however, which has been done over and over again with, so far, no tangible benefit. M. Hoho does not quite like to start his comparison from coal to lamp in both systems, although he does so to show that he is not afraid of the result. This is his second computation, in which the conversion of energy into light is shown to be from 5½ to ninefold in favor of electricity. He would prefer, as he says, to talk of the conversion of water power into electricity in order to show the electric light at its best; and even then, with a Niagara to draw upon, he would ask chemistry to provide a better kind of filament for his lamps. Provide him with unfailing and illimitable water power, and an ideal lamp, and M. Hoho would indeed laugh gas lighting out of existence.

All the Belgian electrician wants is a good "tap" of pure energy always available, and something that will convert it into light where required with infinitesimal loss, and then he will do good business. Unfortunately for this way of handling the question, energy is not, never has been, and never will be in demand. It is an abstraction, the conception of which has been of great service to the man of pure science; but when it is dragged into commercial discussions, it makes him who misuses it so appear ridiculous. The world wants light, heat, power, electricity, magnetism, just as it wants diamonds, sugar, jet, and coal. It will ask for "energy" at about the same era that it will demand "carbon" over the counter. Sooner or later, theorists like M. Hoho must come to a stand over the commercial question, however desperately they may try to ignore the existence of any such consideration. M. Hoho may "sentence" gas to extinction as frequently as he likes; but people who never heard of "energy" in the sense in which he uses the term, will continue to find gas cheaper than electric lighting. When he babbles of "energy" and means light, he compels us to imagine how a chemist would fare if, when asked by his wife for diamonds, he should offer her a piece of blacklead with the assurance that it was essentially the same thing. Abstractions are for the abstract, and cannot be confused with the concrete except at the bungler's peril. Papers like that of M. Hoho are interesting enough so far as they go, and so long as they are confined to their proper region. When used in an inappropriate sphere, however, they strike a critic chiefly by their incongruity of terminology and object.

Candle Power of Electric Lights.

The following is taken from the *Engineering and Building Record*:

Mr. Samuel C. Lancaster, City Engineer, Jackson, Tenn., writes: "Can you tell me how I may ascertain the actual duty, or candle power, of a Brush electric light? There is a controversy between our city fathers and the manager of our electric lighting plant as to the candle power furnished, their contract requiring 2,000 candle power to the lamp, which, the city believes, they fail to furnish. How can we test this, and is there not some gauge made for the purpose?"

[The intensities of all lights are measured by comparison with the lighting power of standard sperm candles; hence the term candle power. Probably the simplest form of apparatus, or photometer, for making the necessary measurements is that devised by Bunsen. It consists of a paper screen, on which is a grease spot, making that particular part translucent. The principle of the device may be briefly outlined as follows: If the paper be illuminated by a light placed in front, the spot appears darker than the surrounding space. If, on the contrary, it be illuminated from behind, the spot appears light on a dark ground. If the greased part and the rest appear unchanged, the intensity of illumination on both sides is the same. In applying the apparatus the standard light is placed on one side of the screen; the light to be tested is on the other side and is moved in a straight line to such a distance from the screen that there is no difference in brightness between the greased part and the rest of the screen. By then measuring the distance of the lights from the screen their relative illuminating powers can be determined, being respectively as the squares of their distances from the screen. Several other forms of photometer have been designed, such as Rumford's and Wheatstone's, but the one just described is probably most extensively used.

The standard sperm candle, of which there are six to the pound, burns 120 grains an hour, and is the light standard in this country and in England. Argand gas burners are sometimes used, as may be suggested by any particular case, in place of standard candles, having first, however, been compared with the standard candle, so as to obtain for them a definite measure of lighting power. The standard in France is the Carcel lamp, which equals 7.4 standard candles. The difficulty of getting carefully made candles to give a light sufficiently uniform for standard purposes has led, in some cases, to the adoption of special units consisting of lights formed by burning certain mixtures of gas and air, at certain rates of combustion, in specially constructed burners so as to produce flames of definite height. These have been found to answer well in practice.

As regards the actual lighting powers of any of the electric arc or incandescent lamps on the market it is no secret that they fall far below the commercial ratings. There seems to be a tacit understanding that a 2,000 candle power arc lamp does not develop anything approaching the light of 2,000 standard candles, nor that the much-used 16-candle power incandescent lamps really equal 16 standard candles in illuminating power, and the same is true of all intermediate ratings. Just why it should be so is past finding out. As a matter of fact a so called 2,000-candle power arc lamp generally falls short of even 1,000 candles in lighting power, and 16-candle power incandescent lamps rarely give a light of more than from 12 to 14 candles. The claim of the electric lighting plant manager at Jackson, that his 2,000-candle lights are 2,000-candle lights *actually* is certainly exceptional, and would probably not be substantiated by actual test.

In classifying lamps as regards lighting power it must also be borne in mind that the intensities vary at different angles. Experiments recently made in Germany to determine the candle power of arc lamps showed that in a Siemens differential lamp, supplied with a current of 14 to 15 amperes at from 48 to 52 volts, the horizontal intensity was about 196 candles (German very nearly the same as English): it increased rapidly to about 20 degrees below the horizontal, where it was 1,150 candles, then more slowly until it reached a maximum at about 42 degrees below the horizontal plane, where the light was 2,014 candles; it then began to sink rapidly until below 60 degrees there was no light but only shadow. The average intensity was 1,228 candles, with the globes on; the actual light obtained ranged from 510 candles downward to 1,183 in a direction inclined 40 degrees below the horizontal, with an average illuminating power of 834 candles when freshly whitened reflectors were used.

The fact that electric light men themselves admit the shortcomings of the present system of lamp classification was very strikingly brought out at the recent Cape May, N. J., convention of the National Electric Light Association. Dr. Louis Bell, of New York, in there discussing the shortcomings of the adopted ratings, with special reference to incandescent lamps, added: "With the arc lamp we unfortunately know that the case is even worse. * * * We know only too well that the nominal candle powers of arc lamps are quite different from the real. The whole subject is in a tangle which at first seems almost hopeless. Heretofore it has not been specially important in the early stages of electric lighting, because people did not look so closely then into the exact conditions under which the light which they purchased shall be given; but as the electric lighting business comes more and more down to close competition and hard commercial lines it becomes more and more necessary to look after these things, and to define just what we mean by the lights which we contract to furnish, and to arrange some way by which there shall be a general consent as to the meaning of the terms which we use."

Mr. Alexander, in speaking on the same subject, called to mind a measurement, made three or four years ago, by which it appeared that a 2,000 candle power arc lamp varied from 134 to 1,386 candles, according to the measurements made then; but still they were all called 2,000-candle power lamps. These and many other similar points brought out at the Cape May meeting would seem to show very conclusively that, in general, users of electric lights are paying for something which they do not receive.

In the case of our correspondent we can suggest only that the question might be settled satisfactory to all concerned by having photometric tests made of the lamps in dispute by some electric expert. The average candle power would be the result to be determined and on which, no doubt, the claims of the electric company are based.]

Some Special Lamps Made at the Edison Lamp Works.

By Mr. F. E. Jackson.

It is desired to call the attention of the managers of the illuminating companies and others to a few lamps provided by the lamp works, which are designed for special uses: with the exception of the "small battery lamps," the lamps to be described have not been long on the market and are but little known.

The small low-volt lamps, which are made for use with primary batteries, have been manufactured for several years, and are more or less known to all, although comparatively few have been used in central stations; until recently comparatively few have been made, but now the demand is increasing rapidly.

The one purpose for which these lamps were made was, as their name indicates, for use with batteries, and particularly with primary batteries. The e.m.f. of the lamps is very low, varying from 10 to 12 volts in the 6 c.p. lamps to as low as 2½ volts in the ½ c.p. lamp made for the use of surgeons and dentists. The e.m.f. is purposely made low so that the lamps can be used with the least number of cells of batteries. It should be noted that not less than two cells can be used with any of the lamps.

The lamps vary in candle power from ½ to 6 candles; they are also made of ½ candle power in the special forms of "dental," "surgical," and "pea" lamps. The efficiencies are high, as they should be where current is as costly as it is when primary batteries are the generators.

It was stated that not many of these lamps had been used until within a short time. The reason no doubt is that they were not advertised in a way that would bring them to the notice of possible purchasers.

A small pamphlet descriptive of the lamp and of cheap batteries that can be used with them is now issued by the lamp works, and the lamps have lately been advertised more extensively in other ways; the results are easily seen in the number of lamps ordered. Also there have been so many orders received for material for making the batteries described in the catalogue that it was decided to make up complete outfits, and these are now made and kept in stock.

About a year ago there was a demand for small lamps suited for burning in series on the regular 110 volt lighting circuit. Before the time mentioned there had been no special demand for lamps to be burned in series, and no lamps had been made for that purpose. The "battery" lamps were used in this way in a number of cases, but they did not always give satisfaction; it was found that to give the best results when used in this way the carbons in the lamps should be made of different proportions and different dimensions.

The lamps then made for burning in series on the dynamo circuit have given very satisfactory results; they are the lamps which were used in the electrical exhibition at the Lenox Lyceum, New York, during last winter, and which are used here at the Minneapolis Exposition, where they speak for themselves.

The "small series burning lamps" are made higher in voltage and of lower efficiency than the battery lamps. They are made from 1 to 4 candle power. The voltage of all lamps is about 14 volts; so 8 lamps of any one candle power can be burned in series on the 112 volt circuit.

The lamps are made of efficiencies varying in different lamps from 3 to 5 watts per candle. The lamps are tested and marked for the current they require when burning at normal candle power, and those taking the same amount of current are selected for burning in series together. When a dynamo is used as the generator the cost of producing current is low as compared with the cost of the current from a primary battery; therefore high efficiency is not so great an object. As the lamps are burned in series, the breaking of one lamp stops the flow of current in several others, making it appear as though the lamps broke more frequently than they actually do. The comparatively low efficiency of the "series" lamp is an advantage, as the increased lamp life which comes with a decrease in efficiency reduces the number of renewals proportionally, and also prevents the annoyance which would be the result if the lamps broke more frequently.

Some tests in order to determine the best efficiency to give these "series burning lamps" are now being made at the lamp factory. So far the results are very satisfactory. At the time of this writing only one lamp has broken, and that was at the end of 320 hours. The number of lamps burned in the test was 22. Another set of 33 lamps has been burning for 250 hours, and no lamps have been broken.

The lamp which it is believed will become the most popular one for decorative purposes and for producing scenic effects has not yet been used outside of the factory, the lamps having been made only during the past few weeks. The lamp referred to is the 1-candle power, 14-volt or "eight in series" lamp. For use in fancy designs and in producing effects where it is the effect only and not illumination that is wanted, the results obtained with the 1-candle power lamps are quite as good as those obtained with the lamps of higher power.

The decided advantages in using the 1-candle power lamps are that less current is required than for the 3 and 4-candle power lamps, and the heating effect is less also.

In the exhibition we have an illustration of some of the uses to which these small lamps can be put, but there are many ways in which they can be used with profit on a smaller scale by the illuminating companies. A profit can be derived from the sale of current to light them.

At the lamp works several fancy designs have been gotten up when called for, in which the small lamps are arranged in the form of letters, spelling words and names. The lamps have also been arranged in other forms, such as stars. With suitable switches the lamps forming letters, words, or different parts of designs can be lighted or turned off at will, attracting the eye and producing pleasing effects.

The lamps are made of different colors. The colors in which they are now made are red, blue, violet, green and amber. These colored lamps have been made only during the last few weeks, and they have been used only to a limited extent as yet. It is hardly necessary to say that with the colored lamps the number of combinations and effects that can be produced is greatly multiplied.

Another lamp to which it is desired to call attention is that specially designed for use on power circuits where lamps are burned in series, and particularly for use on the 500 volt street railway circuit; in fact, the lamp is called the "electric railway lamp," and it is so labeled.

When the electric railway business was first started it was intended, of course, to use incandescent lamps; but the question of the proper lamp to use was of small importance in comparison with others, and it was neglected in consequence. The lamp generally used on the Sprague roads when they were first started was the regular 100 volt 16 candle power lamp, the lamp of highest resistance and highest efficiency.

The importance of selecting lamps taking the same current when they are to be burned in series was not considered, and very often—I think I may say that on almost every road—lamps of different sizes and of different manufacture have been placed in the same series, with results not always explained or accounted for, but apparently unfavorable, by comparison with the lamp taking the least current under normal conditions.

If a lamp of higher candle power, or if any lamp of equal voltage and taking a greater current, is burned in series with a high efficiency 16-candle power lamp, the result is that the 16-candle power lamp receives the greater pressure; and if the pressure is normal for burning two similar lamps in series, the 16-candle power lamp would be forced above normal candle power, and would soon be broken, if not broken immediately.

The Edison lamp has been the lamp of highest resistance on the market, and therefore it has been the one to suffer most for the above reason. As before stated, the Sprague roads have generally used these lamps at starting. No special lamp was made for the use of railway companies, and no particular lamp has, in most cases, been recommended; consequently all lamps have been considered as being alike and suitable for burning in series, particularly if they had the same marks for voltage. The natural result has been that dissimilar lamps have been placed in the same series, and the 16 candle power Edison lamps have often given a very short life, when, if they had been used alone, they would have given the best results. For the reason that the causes mentioned have not been understood, a large part of the lamp renewal business has been lost to the lamp works and to the illuminating companies.

The difficulty has been recognized by the lamp works, and we believe that it has been effectually provided against in the "electric railway lamp," which has but lately been put on the market.

These "electric railway lamps" are designed particularly for the use of railways, but they are equally well suited for use on other power circuits, or in all other cases where lamps are burned in series on circuits of 200 to 500 or 600 volts. The lamps are made to give 16 candle power. The voltage ranges from 95 to 100 volts, and they take currents varying in different lamps from .60 to .75 ampere. The lamps have a special label, and the normal currents, the fractions of an ampere required to bring the lamps to 16 candle power, are marked on the labels.

The lamps are selected for voltages ranging from 95 to 100 volts, but the voltage is not marked on the lamps, the marks for voltage have been found to produce confusion; customers, in some cases at least, have supposed that all lamps having the same marks for voltage were suited for burning in series as well as for burning in parallel circuit, whether the lamps were of the same resistance or not. For this reason the marks for the voltage of the lamps are omitted altogether.

As the regular 16-candle power lamp has a very fine and delicate car-

bon, it was thought best, in designing the "railway" lamp. to give it a stouter carbon, such as would not be so easily injured by the mechanical strain to which the carbons of the lamps are subjected. Also, very high efficiency is not to be desired in these lamps, on account of the constant variation in the e.m.f. on the circuit. The efficiency of the lamp as determined on is about 4 watts per candle. Lamps of this efficiency will give the best results; the voltage on the circuit can fall considerably below the 500 volt limit, as it is constantly doing on the railway circuits, without bringing the lamps to a very low incandescence; also an increase in pressure of 10 per cent. will not cause the lamps to break at an abnormal rate.

Although the lamps in the regular stock will vary so as to take currents varying in different lamps from .60 to .75 ampere, it is not supposed that the lamps taking this whole range shall be sent to any one place. For any one plant the range of currents taken by the lamps will be limited to about 3-100 ampere, or all lamps sent to any one plant will be practically identical.

At the lamp works and at other places where the "railway" lamps will be kept in stock, records of the amperage or the currents taken by the lamps sent to the different plants will be kept, so that it will always be known just what lamps are wanted when lamps are called for by the railway company's renewal orders, and lamps of the same resistance will always be sent for use on the same circuits.

Electric railways are being introduced very generally now, and such a large number of lamps are being consumed by them that it is well worth the while of those interested to look after the lamp renewals, and see that the best lamps are used.

Where there are different roads in the same town, or where there are several different branches of the same system, it would be an advantage to have signal lamps of different colors on the different cars to distinguish those on one branch from those on another. Such colored lamps will be provided by the lamp works. We can now provide them of five different colors. When colored lamps are ordered by the railway companies, the lamps will be selected for the currents taken in the same way that the plain lamps are selected, so that all will be suited for burning in the same series.

On the street cars colored lamps can be placed on the front and rear platforms, and in conspicuous positions to serve as signal lamps, while the remaining three lamps in the series are used to illuminate the interiors of the cars.

It may be added that the lamps will be made with bases other than the Edison bases, but, unless some other base or plug is specified, all lamps will be made to fit the regular Edison socket.

Some Applications of Electricity in Engineering Workshops.

By Mr. Charles F. Jenkins, B.A.

During the last year and a half the author has had the opportunity of making experiments on electric motors in the Crewe works of the London and Northwestern Railway. Some of the results of these experiments are given in the following paper. It must be understood, however, that none of the experiments were made with a view to their publication, and they consequently lack, to a certain extent, the accuracy and completeness desirable for this purpose.

It is necessary, for the successful introduction of electrical transmission of power into workshops, that the motors used should be as cheap as possible, and also, in many instances, as light as possible. This double requisite of cheapness and lightness leads to the consideration of what material is the best for the construction of the magnets and framework, since these form the heaviest part of the motor, and also allow of more variation in design than the armature and commutator.

It is generally found not to be desirable to magnetize cast iron more than half as highly as wrought iron; consequently the relative weights of cast iron and wrought iron must be as 2 to 1. On the other hand, cast iron may be very cheaply obtained in any complex shape desired in order to simplify the framework of the motor. From these considerations it will be evident that any material capable of being cast, and yet having a higher magnetic permeability than cast iron, would be of great use in the construction of motors. The use of steel castings for this purpose was suggested to the author last year by Mr. F. W. Webb, M. Inst. C.E., and, in order to find out the suitability of this material, the author made a magnetic test of two different qualities of steel castings, which appears to show that cast steel lies in an intermediate position between cast iron and wrought iron in its suitability for magnets.

A chemical analysis of the samples tested was made at the laboratory of the works, to determine the quantity of carbon in the steel. The amounts were found to be as follows:

	Per Cent.
Sample I.—Combined carbon.....	0.6
Sample II.—Combined carbon.....	0.28

The first motor constructed with cast steel magnets was designed by the author for driving a portable drill. Before describing this motor and drill, it may, perhaps, not be out of place to consider a few of the factors which determine the design of small motors.

The electro-motive force of the leads off which it is to run is a very important factor. For instance, a small armature can be easily wound with 480 turns of No. 18 to run with 50 volts, but it becomes troublesome to wind it with 1,440 turns of No. 24 to run with 150 volts. Thus the size of the armature must be kept sufficiently large to make the winding fairly easy.

Again, the speed is very important. Of course, the faster the motor runs, the smaller it may be, and the fewer the turns required on the armature; but then the difficulty of gearing increases, and the mechanical construction must be very good for high speeds.

Also whether the motor is to be shunt or series wound is an important factor in determining the shape of the magnets. In a series-wound motor, the magnets may be of any form desired, since the winding, consisting of comparatively few turns of thick wire, can be put on by hand. But in a shunt wound motor it is almost essential, especially in high-voltage machines, to make the magnet cores straight, so that the winding can be put on in a lathe. This difference in the shape of the magnets causes small shunt wound motors to be heavier than series ones, since it is impossible to arrange them so compactly. The difficulty of winding shunt magnets becomes considerable when high voltages are used, as the wire has to be very small.

This points to the advisability of using series winding, where possible, and for steady work there is no reason against it; but, where the load varies much, the difficulty of governing becomes very serious. This difficulty does not arise with shunt or compound-wound motors.

The motor in question was required to drill holes up to ¾-inch diameter in wrought iron or Bessemer steel, and there was considerable difficulty in estimating the power necessary for this purpose, as neither the power, nor the proper speed of running, nor the rate of feed for drilling holes in metal, could be found in any of the reference books available.

The author, therefore, made a few rough experiments on a common drilling machine, to find out the power and rate of feed required. The drilling machine was driven by a belt from a countershaft overhead, the belt being brought down on each side of the machine, and under two jockey pulleys, which were weighted sufficiently to give the belt the necessary grip. The difference between the weights on the two sides of the belt was adjusted so that both jockeys could be kept floating when the drill was working at the desired rate. The speed and rate of feed experimented on were the greatest generally used in the shop and the experiments showed that about ½-horse power was the maximum power required to drive a ¾-inch drill when it was fairly sharp, cutting in Bessemer steel at the rate of about ¼-inch a minute.

The speed chosen for the electric drill was 60 revolutions per minute running light, or about 45 loaded. The motor was designed to run at 3,000 revolutions, and a steel worm on the shaft was arranged to gear into a brass wheel on the drilling spindle, thus reducing the speed in the ratio 50 to 1.

In the design of the drill the armature was overhung, the spindle running in two bearings, one on each side of the worm, the end thrust being taken on the end of the spindle. The brushes were carried on two small studs fixed on the poles of the magnets.

The magnets are wound with 9,800 turns of No. 27, the resistance being 332 ohms, for working at 150 volts. Before this winding was put on, a temporary winding was put on for separately exciting them for testing.

In order to test the performance of the motor, a brake test was made on full load. The load was increased slowly until the maximum safe temperature of the armature was reached. The motor being run for over two hours to make sure that the heating of the armature would not be too great. The brake used consisted of a leather strap hung over a wooden pulley on the motor spindle, which was lubricated by a continuous stream of water. Both ends of the belt had weights attached to them, and the light end was partially supported when the motor was running on a Salter's balance. This arrangement worked very much more steadily than when the balance was put on the heavy side of the belt.

The weight on the strap increased the friction in the bearings of the motor to a small extent; but no allowance was made for this in working out the results.

The brake test gave the following result with the 50-volt armature:

2,950 revolutions.
26.6 amperes.
47.7 volts.
B. H P. 1.05.
Efficiency, 59.2 per cent.

It was impossible to test the 150-volt armature on full load, as there was not a sufficient electro-motive force available; but it was run to determine the maximum current which it would carry, which was found to be 5.6 amperes. If the efficiency of this armature is the same as that of the other, the maximum power will be 0.67 B. H P.

The efficiency is not very high, but it must be remembered that, in designing the motor, lightness was considered of greater importance than very high efficiency. The weight of the motor alone, without the drilling spindle, cannot be given quite fairly, since the magnets have been used to form part of the framing for carrying the drilling tackle. The weights of the different parts, so far as they could be taken to pieces, are as follows:

	Pounds.	Ounces.
Magnets, bearings and brushes	32	12
Armature	8	8
Boring tackle	15	4
Total	56	8

These figures bear out the claim made by the author for the advantages of cast steel over cast iron, and the general design of the drill will show how much more cheaply the parts can be cast than forged. In comparing the weight of this motor with others, it must be remembered that it is a shunt-wound machine.

After the brake tests had been made on the motor, the drilling spindle was fitted on, and experiments made on the power required for actual drilling. These experiments showed that the motor was amply powerful enough for its work.

A ¾-inch hole could be drilled through a ¾-inch iron plate in 45 seconds, the electric power required being 0.732-horse power. To test the efficiency of the machine in actual use, a spring balance was attached to the arm used for preventing the machine from turning round, and the pull on it observed whilst the drill was at work. This gave the useful power. The electric power supplied to the motor was measured at the same time. The gross efficiency obtained in this way was found to be 34 per cent.

The next motor that the author designed was for driving a small saw for cutting tubes out of boilers. The copper tubes in locomotive boilers have to be renewed from time to time, and the machine about to be described was designed to facilitate the removal of the tubes by sawing them off just inside the tube plate. Mr. Webb suggested to the author the use of a double eccentric motion similar to that used on an inside grinding machine made by Messrs. Beyer, Peacock & Co. This double eccentric motion is fitted inside a plug which fits into the ends of the tubes. The saw spindle runs in a bearing in the innermost eccentric, and is either central or eccentric in the plug according to the relative position of the two eccentrics. Thus the saw is brought into its central position while the plug is introduced into a tube end, and is then thrown out of center so that it cuts into one side of the tube. By turning both eccentrics together the saw is made to cut all round the tube, after which the saw is again turned into its central position and the plug withdrawn. The plug is attached to the motor frame by a long pipe inside which the saw spindle runs, which is coupled direct on to the motor spindle. Handles are attached to the motor frame for manipulating the apparatus. Stops are arranged on the eccentrics in the plug, so that, by simply turning the motor frame through 1½ turns in one direction, the saw is first thrown out of center, and then caused to cut all round the tube. Half a turn in the reverse direction throws the saw back again into a central position, and allows the plug to be withdrawn.

A totally different design of motor from that used for the drill was adopted for the tube cutter. It was thought advisable to use a series-wound motor, so it was no longer necessary to have straight magnets. In order to reduce the magnet winding as far as possible, a Pacinotti-Gramme armature was used, and only $\frac{1}{32}$-inch air space allowed on each side.

The magnets are made out of a single wrought iron forging, on to which are bolted the two phosphor-bronze brackets forming the bearings. The tube which carries the plug is screwed on to a boss on one of these brackets. Each magnet is wound with 190 turns of No. 14 double cotton covered wire. The resistance of both in series is 0.44 ohm.

The motor was designed to run at 3,000 revolutions with 150 volts. This motor has not been tested on full load; but its efficiency has been tested by Swinburne's method. The maximum safe load was calculated by comparison with the drill motor. The result of these tests is as follows:

Maximum load. Watts absorbed .. 2,600
Efficiency..... 71.7 per cent.
B. H P..... 2.5 H P.

The weight of the motor alone is 60 pounds. There are 3 times the number of turns on the magnets which are required for running at full load, 63 turns being then sufficient. The extra turns were put on to keep the speed moderate on light loads.

As the motor has to be stopped after each tube is cut to avoid the danger of the saws catching in the side of the tube as it is withdrawn, it is of great importance to be able to stop and start the motor rapidly. It is also necessary to prevent the motor's running away when there is no load on it. For this last purpose a resistance is put in shunt across the brushes of the motor, which allows sufficient current to flow to maintain the strength of the magnets. For starting, it is found that if the current is switched straight on to the brushes without extra resistance, the magnets give a very violent kick in the opposite direction to that in which the armature rotates. This is so unpleasant to the man holding the machine that it has been found advisable to have a double contact switch, by which the current is first switched on through a resistance, and then direct. For quick stopping, short circuiting the brushes was tried; but this brought up the armature too suddenly, and caused excessive sparking at the brushes. But this difficulty was overcome by inserting a small resistance. It was found possible to stop very quickly by this means without much sparking.

A number of different methods of connecting up the motor with resistances were tried with varying success, until a method was devised whereby both the extra resistances required for stopping and starting were done away with, and only one in shunt to the armature retained.

The way this was done, a three-way switch was placed on the motor and a single resistance box, which stood near the machine when at work. There are four wires connecting this box, which acts as the terminal for the main leads, to the machine itself. They are all flexible wires and made up into a single cable.

For starting, the switch is put on to the middle contact for a few seconds, then on to the top contact. For stopping, it is pulled over on to the bottom contact, where it remains. The bottom contact is connected to the middle of the magnet-winding, thus the magnet-winding acts as the resistance through which the brushes are short circuited. In actual work it was found that the time taken to cut off 1 tube was 20 seconds, including starting, stopping and putting into a fresh tube; that is to say, the machine will cut off 3 tubes in a minute.

(To be continued.)

Cements for Rubber and Gutta Percha.

In making a cement one should know pretty thoroughly, says *The Rubber World*, what is to be expected of it before they could advise upon it. For instance, an ordinary rubber cement will hold on a host of different surfaces and with the best of success, except where there is continued dampness. For holding to damp walls, or surfaces where there is a constant presence of moisture, there is nothing equal to Jeffry's marine glue, the formula for which has been published and republished all over the world. It consists of:

1 part indiarubber.
12 parts coal tar.
2 parts asphaltum.

The rubber, after having been massed, is dissolved in the undistilled coal tar, and the asphaltum is then added. This glue, as its name indicates, is oftentimes used for mending articles at sea, or patches, for instance, that are to be laid on surfaces that are to be under water, and it has been found to be a most excellent thing. Of glass cements there are a great many, rubber, as a rule, being dissolved in some very volatile solvent and some hard drying gum is added.

A gutta-percha cement for leather is obtained by mixing the following. It is used hot. Gutta-percha, 100 parts; black pitch or asphaltum, 100 parts; oil of turpentine, 15 parts. An elastic gutta-percha cement especially useful for attaching the soles of boots and shoes, as on account of its great elasticity it is not liable to break or crack when bent. To make it adhere tightly the surface of the leather is slightly roughened. It is prepared as follows: By dissolving 10 parts of gutta-percha in 100 parts of benzine. The clear solution from this is then poured into another bottle containing 100 parts of linseed oil varnish and well shaken together.

Good rubber cement for sheet rubber, or for attaching rubber material

of any description or shape to metal, may be made by softening and dissolving shellac in 10 times its weight of water of ammonia. A transparent mass is thus obtained, which, after keeping three or four weeks, becomes liquid, and may be used without requiring heat. When applied it will be found to soften the rubber, but when the ammonia is evaporated it forms a kind of hard coat, and causes it to become both impervious to gases as well as liquids.

Davy's universal cement is made by melting four parts of common pitch with four parts of gutta-percha in an iron vessel and mixing well. It must be kept fluid, under water, or in a dry, hard state.

A very adhesive cement, especially adapted for leather driving belts, is made by taking bisulphide of carbon 10 parts, oil of turpentine 1 part, and dissolving in this sufficient gutta-percha to form a paste. The manner of using this cement is to remove any grease that may be present in the leather by placing on the leather a piece of rag and then rubbing it over with a hot iron. The rag thus absorbs the grease, and the two pieces are then roughened and the cement lightly spread on. The two pieces are then joined, and subjected till dry to a slight pressure.

A solution of gutta percha for shoemakers is made by taking pieces of waste gutta percha, first prepared by soaking in boiling water till soft. It is then cut into small pieces and placed in a vessel and covered with coal tar oil. It is then tightly corked to prevent evaporation, and allowed to stand for 24 hours. It is then melted by standing in hot water till perfectly fluid, and well stirred. Before using it must be warmed as before, by standing in hot water.

A cement for uniting indiarubber is composed as follows: 100 parts of finely chopped rubber, 15 parts of resin, 10 parts of shellac; these are dissolved in bisulphate of carbon.

Another indiarubber cement is made of: 15 grains of indiarubber, 2 ounces of chloroform, 4 drachms of mastic; first mix the indiarubber and chloroform together, and when dissolved the mastic is added in powder. It is then allowed to stand by for a week or two before using.

Cement for sticking on leather patches and for attaching rubber soles to boots and shoes is prepared from virgin or native indiarubber, by cutting it into small pieces or else shredding it up; a bottle is filled with this to about $\frac{1}{10}$ of its capacity, benzine is then poured on till about three parts full, but be certain that the benzine is free from oil. It is then kept till thoroughly dissolved and of a thick consistency. If it turns out too thick or thin, suitable quantities must be added of either material to make as desired.

An elastic cement is made by mixing together and allowing to dissolve the following: 4 ounces of bisulphide of carbon, 1 ounce of fine indiarubber, 2 drachms of isinglass, ½ ounce of gutta percha. This cement is used for cementing leather and rubber, and when to be used the leather is roughened and a thin coat of the cement is applied. It is allowed to completely dry, then the two surfaces to be joined are warmed and then placed together and allowed to dry.

Cement used for repairing holes in rubber boots and shoes is made of the following solution 1. Caoutchouc, 10 parts, chloroform, 280 parts. This is simply prepared by allowing the caoutchouc to dissolve in the chloroform. 2. Caoutchouc, 10 parts, resin, 4 parts, gum turpentine, 40 parts. For this solution the caoutchouc is shaved into small pieces and melted up with the resin, the turpentine is then added, and all is then dissolved in the oil of turpentine. The two solutions are then mixed together. To repair the shoe with this cement. First wash the hole over with it, then a piece of linen dipped in it is placed over it. As soon as the linen adheres to the sole, the cement is then applied as thickly as required.

Mining Dangers and Their Prevention.

The *Mining Journal's* Paris correspondent claims that the late explosion at the Villebœuf colliery, at St. Etienne, has given rise to a great deal of discussion as to the necessity of adopting some efficient precautionary measures against the dangers attending the presence of fire damp in mines. A commission was appointed soon after the catastrophe to examine into the causes of the explosion, and to elicit from competent authorities the measures that would be most likely to prevent a recurrence of such a melancholy event. Such steps have been frequently taken in the past with a view to devising means for protecting the miners, and nothing has been done beyond confirming the most elementary precautions which had been in vogue since the first application of science to the safe working of fiery mines. The commission that was recently appointed, however, is now working with an earnestness that gives promise of something definite being done towards ameliorating the condition of the getters of coal, but it has to encounter so many difficulties in the course of inquiry that it is to be feared that the results will not be wholly commensurate with the seriousness of its intentions. For instance, the commission has to meet at the outset the repugnance of the miners to the use of the safety lamps. Those survivors of the catastrophe who were examined showed a curiously dogged aversion to the employment of the really effective means of avoiding explosion which is afforded to them by the safety lamp, and they attribute the recent explosion almost wholly to the absence of a sufficient watering of the mine. While the collier will persist in his antagonism to the safety lamp, and will sacrifice the most necessary precautions to his temporary convenience, it seems to be really difficult, without a costly system of supervision, to prevent him from imperilling the lives of the whole of his fellow workmen in the mine. Whether the French miner is really ignorant of the danger in which he places the mine by indulging in a furtive pipe, or in surreptitiously opening his lamp so as to throw a better light on his work, he certainly endeavors as much as possible to avert the blame from these, it is to be feared, very common indiscretions. It has even been suggested that these explosions of fire damp have been frequently caused by the emission of sparks from a contact of the pick with the mineral. This apparently feasible theory was received with some credulity until it was completely refuted the other day by experiments that were made at the *Ecole Nationale Superieure des Mines* by a commission under the presidency of M. Haton de la Goupiliere, Inspector-General of Mines. It was then conclusively proved that it is impossible for the fire damp to be ignited by sparks from the pick, whether the fire damp is pure or mixed with air. In order to produce an explosion it was necessary to mix the fire damp with 50 per cent. of another combustible gas; but as the fire damp in mines is never found to contain more than from 3 to 4 per cent. of foreign gas, it is obvious that any danger from ignition of the fire damp by sparks is merely visionary.

Among the prolific suggestions that are being made by mining authorities for the safe working of mines the two points around which they all seem to converge are the adoption of an electric safety lamp and the provision of efficient ventilating appliances. The discussion which is taking place between the advocates of these two possible means of avoiding explosions is characterized with so much dogmatism as to illustrate the saying which asks where doctors disagree who shall decide? The party who uphold the ventilating theory pay an utter disregard to the value of safety lamps, and the advocates of electric safety lamps believe that in these appliances perfect safety is to be secured. The most uncompromising opponent of the electric safety lamp is M. Audiffred, who said in the Chamber the other day that it was practically impossible to use the electric safety lamps in mines, on account of their conveyance being rendered very difficult by the weight of the accumulator, which he said was nearly 8 kilometers. The light, moreover, would not last sufficiently long for the purposes of the miner, 4 or 5 hours being the maximum time the light would hold out. The cost of 2 or 3 francs a day for each lamp was, he urged, another impediment to their use, since the colliery proprietors could never endure such an enormous addition to their working expenses. This statement, however, is hardly consistent with the improvements that have lately been made in electric safety lamps, and which have rendered them so cheap and convenient as to allow of their use in the Government powder factories and in the establishments of the Gas Company of Paris. As regards the assertion that the accumulators are too cumbrous and heavy to allow of easy portability, the only disproof that is necessary is that a lamp called the "pile block" has recently been invented by M. Germain which has an accumulator weighing only 2 or 3 kilogrammes. Other lamps, such as the Constant Rousseau, and the Pollak lamp, which was invented by a man at Buda Pesth, are also illustrations of portable electric safety lamps that are peculiarly applicable to all the exigencies of mining. Another lamp, the capabilities of which have been tested by British colliery proprietors, is the Stella, which was lately presented to the Academy by M. le Comte de Gerson. It has recently been adopted in the fiery mines of Anzin, where it has received the approbation of the engineers. The lamp weighs 1,600 grammes, the accumulators are charged in 5 hours, and it gives a light of 1-candle power for 12 or 16 hours. It is quite obvious, therefore, that the antagonism of M. Audiffred to the electric safety lamp is quite unnecessary, though perhaps any refutation of his arguments will not alter the position which he has taken up on behalf of the colliery proprietors, who are inclined to look carefully at pence while they run in danger of losing pounds. The owners of collieries in France have repeatedly shown their indisposition to accept any reforms in the management of their mines which might involve any additional expenditure out of their own pockets, and there seems to be every probability that the Chamber will have to insist upon the observance of precautionary measures that are now under consideration by the strict operation of

laws that they have already passed and by the passing of new Parliamentary statutes which are urgently required.

One theory upon which experiment might throw important light is connected with a system of ventilation. It is astonishing how many phases of this question are being seized upon by the acute perception of French scientists. The laying of dust by well watering the mine is undoubtedly a step towards rendering the colliery comparatively safe, and this is a contingency which will doubtless be insisted on more rigorously in the future than it has been in the past. The chief phase, however, to which attention is being directed is the possibility of reducing the liability to accident by a treatment of the atmosphere in such a way as to render harmless any fire damp that may be present. This, it is said, may be accomplished by ventilating the mine with humid air, since such an expedient is claimed to make the gases lose much of their explosive force. I am not yet aware that this theory has been put into actual practice, but it may serve as a hint towards solving the problem of rendering the mines free from danger. A really effective system of ventilation is also claimed to have been invented by a gentleman who is regarded as a great authority on mining matters—M. Desbrieres, of Montceau les Mines, Saone et Loire. When all the arrangements for patenting the invention are completed we may probably be hearing something more definite about its capabilities. The question of ventilation is certainly one of the most important that has to be considered in the working of mines, and it is therefore satisfactory that so much attention is now being bestowed upon it in a really scientific spirit.

Another protective measure which it is proposed to enforce with more rigor than has been shown in the past, is the appointment of commissions which shall have the supervision of the mines. The law in this respect has been so exceedingly lax as to render it absolutely nugatory, and it is one of those laws that has existed only in name. Now, however, the commissions will be required to make a stringent supervision over the mines in order to ascertain the presence of danger, and to suggest precautions for the possibility of any catastrophe. One such commission is about to be formed to supervise the mines in the Loire coa. basin. The constitution of this commission is eminently characteristic of the democratic character of all such bodies in France, and it is peculiarly satisfactory as ensuring a careful observance of all requirements of a dangerous mine. One-half of the members will be appointed by the workmen in the mines, and the other half will comprise members chosen equally by the companies and the Government.

The stimulation which has thus been given to the authorities responsible for the safe working of the mines and to the invention and research of practical miners and scientific investigators will, therefore, as the outcome of the lamentable disaster at St. Etienne, compensate in some measure for heavy loss of life that was then experienced. If moreover, the results of these investigations should prove as satisfactory as those anticipated the conditions under which the miners are at present working in France will be greatly ameliorated, and the catastrophe at St. Etienne, in suggesting the means of providing for the safe exploitation of the mines in the future, will be as productive of good quite as much in proportion as the event itself was an evil.

Facts of Interest in Connection with the Public Lighting, New York City.

In his report respecting the public lighting of this city, for the year ended December 31, 1889, Superintendent McCormack, among other things, says:

Gas Burners.—On the 12th day of May, 1823, the first contract for lighting the streets of this city by gas was entered into between the city of New York and the then New York Gas Light Company. The gas burners adopted by the city when gas lighting was introduced were of a capacity to consume three cubic feet of gas per hour, and these, doubtless, were considered ample, inasmuch as the city was then not much larger than some of the towns now existing in this country, and the streets were unimportant and sparsely built upon. Sixty-six years have passed, and our city has grown to be the great commercial metropolis of the Western world, but no advance has been made in the size of the gas burners used for lighting our streets, for our contracts still provide that the burners used in the public lamps shall consume 3 cubic feet of gas per hour, while other cities of this country are using burners capable of passing 5 or 6 feet of gas per hour. It is true that in a few favored localities a sudden advance was made from a 3-foot gas burner to the "arc" electric light. This, however, was in but one-ninth of the city, while the residents of the other eight-ninths have to be content with a 3-foot gas burner, and the property owners of the larger part of the city are taxed for supplying the "arc" light to the few favored localities. It seems to me that the city of New York, the empire city of the United States, should provide all its inhabitants with well-lighted streets, as those tend to the comfort, protection and convenience of the people, besides materially acting as a valuable adjunct to the police. Of course, the adoption of larger gas burners would materially increase the cost of the public lighting, but the increase would only be for the additional amount of gas consumed, as the expense of lighting, cleaning and maintenance would remain the same. It seems to me, therefore, that this is a matter which might be properly considered by the Gas Commission.

* * *

Electric Lighting.—The lighting of our streets and public places by electric lights during the past year has been bad in the extreme, and the people have doubtless been greatly inconvenienced thereby. On three different occasions portions of our city have been shrouded in darkness in consequence of the extinguishments of the electric lights. On April 16 (Centennial week) a large portion of the Brush district was thrown in darkness by the company because of the cutting of the wires in Broadway by orders of the Board of Electrical Control, and the gas lamps had to be relighted and then extinguished when the electric lights were again started. On October 11 the Western Union lineman was killed by an electric shock while working on the telegraph wires on the pole at Chambers and Center streets, the telegraph wires having been crossed by an electric light wire at some distance from the spot. On October 14 the United States and Brush Companies discontinued lighting, and all the streets and parks in these two large districts were thrown in darkness. On October 16 the Mount Morris Company did no lighting and this district was thrown in darkness. On October 15, 16, 17 and 18, the Harlem Lighting Company shut down and more gloom was added to the city. In the meantime, the city authorities being enjoined from interfering with the wires of the electric light companies through an injunction obtained from a Justice of the Supreme Court, the companies improved the opportunity by removing their old "underwriters" wire and and substituting new and heavily insulated wire, and then the lights were again started. On December 13 the injunction was dissolved by the Supreme Court General Term, and on Saturday 14 the cutting of the wires and removal of poles was commenced, and on that night the districts of the United States, Brush, East River, Mount Morris and Harlem Companies were thrown in darkness, all these companies having shut down. On December 16 the Mount Morris Company started up, and on 15th the Harlem Company started. On December 14 the wires of the North New York Company were cut and this company shut down. By these several extinguishments of the electric lights 56¼ miles of streets and 66 acres of parks were thrown in darkness. In $3\frac{7}{16}\frac{5}{5}$ miles of streets electric lamps have been relighted, and these remain lighted.

In addition to the above-mentioned extinguishments the police reports show that very many electric lamps have been found not lighted during the year, the extinguishments lasting from 10 or 15 minutes to all night in various parts of the city; in some cases entire circuits have been temporarily shut off in consequence of some defect at the generating station, and the extinguishments have occurred on Broadway, north of Fourteenth street, and in Madison and Union Parks, which places are lighted from the subway, as also in streets lighted from aerial wires.

The extinguishments of the past month were, to this Bureau, a very serious affair, and imposed upon us much hard work. The trouble came at an unexpected and inopportune time. The several Gas Companies were unusually busy in stripping, repairing, and recaulking their mains in the numerous streets which are to be repaved by you during the ensuing spring, in order that there might be no necessity for disturbing the new pavement after being laid. The several manufacturers of lamps and lighting fixtures were naturally pressed with work, as is generally the case prior to the holiday season, and then, when the electric lights were shut off, a sudden and very pressing demand was made on Gas Companies and manufacturers for more light and lighting apparatus, consequently this caused me much trouble and some delay in procuring a sufficient number of lanterns for use on the streets from which the electric lights had been cut off. I also found unexpected obstacles in lamp posts from which the service pipes had been disconnected by builders, cellar diggers and others, and by workmen on the electric subway construction, 23 lamp posts having been found on the short piece of Broadway between Houston and Fourteenth streets without gas connections, this having been caused by subway work.

However, on Saturday, December 14, the wires were cut, and on the following Monday we had the gas lamps in all the public parks relighted, and by Friday, the 27th, we had the 56 miles of streets relighted, 4,738 gas lamps having been relighted between the 14th and 28th of December, leaving some scattered gas lamps on side streets adjacent to an avenue yet to be relighted; but this was done by the aid and

co-operation of the several Gas Companies. In regard to the entire stoppage of work by the electric light companies, I am very firmly of the opinion that some of the streets were unnecessarily thrown in darkness, especially in the lower sections of the city, where the wires had not been disturbed. On the afternoon of the day when the wire cutting was commenced, I had arranged with the Gas Company for the relighting of the gas lamps in City Hall and Battery Parks for that very night, and this would have been done had I not been informed by two officers of the electric light company that such action was unnecessary, because the electric lighting would be continued on these parks and on lower Broadway. On that night I visited the lower sections of the city, and, to my great surprise and indignation, I found the above places in utter darkness, notwithstanding the assurance given me that the electric lamps would be kept lighted. Had the company continued the lighting down town, which I am firmly convinced it could have done, we would have had the use of several hundred lanterns for streets uptown.

The streets and public places of this city should never be left in darkness, but at all times of night and under all circumstances artificial illumination should be maintained, and the illuminating material should be such as will afford an absolute certainty of light. Can this be done by means of electric lighting as at present constituted? The experience of the past would seem to indicate that the "arc" light, in its present stage, cannot be relied upon for artificial illumination with any degree of absolute certainty. It seems to me that there are too many possibilities of interruption. The electric current cannot be stored to any extent, and the lights can only be maintained while the wires are intact and the plant at the generating station is in proper working condition.

We have had gas lighting in this city for the last 60 years, and I can find no record of our streets being thrown in darkness in consequence of an accident to a gas works, excepting on one occasion when the gas lamps in a few of the up-town streets were not lighted for one night. There have been fires and explosions, but the gas lamps remained lighted. There are ten gas works on Manhattan Island, with two, three, four, and in some cases six sets of gas mains in the streets; hence no accident could possibly occur at any one of the gas works which would tend to deprive the city of gas.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE business offices of the Citizens Gas Light Company, of Wakefield, Mass., have been removed from Wakefield's Block to the offices of C. F. Woodward, on Albion street.

SOME time ago we noted that certain parties interested in the formation of the Union Light, Heat and Power Company, for Jersey City, N. J., had obtained a franchise from the Council, but that the Mayor was inclined to interpose a veto. This he has done, and his objections to the measure are so tersely put that we herewith reproduce them: "Mayor's Office, Jersey City—To the Board of Aldermen: Gentlemen—An ordinance entitled 'An ordinance to authorize the Union Light, Heat and Power Company, consisting of Andrew Whyte, John A. Bell and Charles O'Donnell, and others who may be associated with them, hereinafter to be incorporated as said Company, to lay pipes, conduits and subways in the streets, avenues, alleys, highways, lanes and public squares in Jersey City for the purpose of conveying and conducting gas for light, heat and power in said city,' passed September 9, 1890, is herewith returned with my objections. The city is incorporated and organized under a charter granted by the State, and all municipal powers are therein defined and set out. It possesses no power not therein specified or granted to it by some other statute. Nowhere in the city charter is the power given to the municipality to authorize any person or persons to tear up the streets and lay down gas pipes. But under a general law on that subject any city may give its consent to a Company, itself duly organized, as set forth in the statute. The consent can only be given to a corporation complete in all its party and ready to begin work. The principles of law that underlie the position I assume in this case are so fully recognized by the courts of this State that there is no room for argument. There is no debatable ground. The matter is beyond even a reasonable doubt. (See the case of Peoples Gas Light Company vs. Jersey City, 17 Vroom, 297). Your Board cannot afford to violate the laws of the State. You have no powers beyond those granted by the State, and the State has invested your board with no power to grant such a franchise. The State itself grants the franchise, while to the city is given only the right of consent to the exercise of that franchise within its territorial limits. But before the State itself can, under the law, grant such a franchise, much has to be done by the proposed gas company. There must be a certificate filed in the office of the Secretary of State, which certificate must contain the names of 13 directors who must be stockholders in the company and residents of this State, and two thirds of whom must reside in the city in which the works are to be constructed. There must be provision for a capital stock equal to not less than $5,000 for every 1,000 inhabitants, which in the case of Jersey City would be a capital stock of not less than $825,000, and before the certificate can be so filed one half of the capital stock must be subscribed for in good faith and 20 per cent. thereof paid in, in cash, to the treasurer of the company. This would require a previous *bona fide* subscription of $412,500, and 20 per cent. thereof would be $82,500 in cash that must actually be paid in. A majority of the directors must make oath that this has been done, after which, on payment of the State tax provided by law for such a case, the certificate can be filed and the organization become a corporation invested with certain rights and franchises, amongst which is the right to lay pipes in the street, but before laying them the company must receive the consent of the city authorities. It will thus be seen that the consent cannot be given till the franchise has been granted by the State, and the franchise cannot be granted till the above requirements have been complied with; even should the ordinance pass neither the persons named nor their successors would be allowed to lay a single foot of pipe in any street in this city; but I am sure that after an examination of the law and the facts no member of your honorable body will insist upon the passage. It is plain on its face that this ordinance is not asked for in good faith. The three persons named know absolutely nothing of the gas business. They were never connected with it in any way. If they were really familiar with and really had the ability or intended to build gas works, they would know the general law of the State regulating the formation of gas companies, and they would know that they could do nothing lawfully under this ordinance. They would know that they had not complied with the State law, and were not in a condition to receive from the city its consent to lay pipes in the streets. For these reasons this ordinance has not received my approval. Very respectfully, ORESTES CLEVELAND."

THE River Forest (Ills.) Water, Gas and Electric Light Company has been incorporated by Messrs. H. E. Broughton, Frank C. Smith and H. Struble. It is capitalized in $150,000.

WE understand that a committee of citizens of Americus, Ga., are considering the advisability of purchasing from the New York Contract Company the gas and electric light plants owned by the Company. In fact the committee has been appointed and is composed of the following members: Colonel S. H. Hawkins, B. P. Hollis, H. C. Bagley, Arthur Rylander and Hon. W. M. Hawkes.

MR. JOHN CLARK has accepted a position with the Fulton-Municipal Gas Light Company, of Brooklyn, N. Y.

MR. C. H. DIFFENBAUGH, Superintendent of the Tyrone (Pa.) Gas and Water Company, has been engaged in bettering the Company's main system. The changes embrace 2,100 feet of 12-inch, 2,100 feet of 10 inch, 900 feet of 8-inch, and 1,100 feet of 4 inch main.

AT last the authorities of Camden, N. J., have come to their senses in respect to the failure of the incandescent lamps of the 16 candle power electric variety to afford the proper volume of light for the streets. In any event, at a recent meeting of Councils, Mr. Burdsell, of the Light Committee, moved that the City Clerk be instructed to notify the Camden Heat and Light Company to extinguish all the incandescent lamps that it has been maintaining in the Second ward of the city. Further, that gas burners be substituted for them. The order was adopted and the change was made on Oct. 1st.

MR. JOHN LILLIE, Secretary and General Manager of the Port Townsend (Washington) Gas and Fuel Company, writes as follows, under date of September 23d: "At the annual meeting of this Company the following named officers were chosen for the ensuing year: President, Oliver E. Fleming; Vice-President and Treasurer, Theron J. Nolton; Secretary and General Manager, John Lillie. We will have our works ready to light up about Oct. 20th, and will start with enough consumers to make the works an assured success. We have over fifty services already in, and applications enough daily to keep our service gang busy."

THE following is from a correspondent, who is a firm believer in the future expansion of Jacksonville, Fla.: "The Jacksonville electric light station, which is a part of the possessions of the local Gas Company, is now one of the most complete and perfectly equipped in the

South, despite which, improvements are being constantly made to keep up the present state of efficiency. Mr. C. S. Hammatt, Superintendent of the combined gas and electric lighting station is always on the look-out for any new wrinkle in machinery or invention which he can advantageously employ, and during his three years' term here he has virtually reorganized the system. A large artesian well is being sunk to increase the supply of water, the present well being insufficient to meet the demands of the lighting plants. The electric station at present can be counted on to supply 200 arcs and 1,800 incandescents. The number of dynamos is 10, and these are driven by four engines aggregating 360-horse power. Every modern electric generating and supply device is availed of, and the service certainly is maintained in excellent style. Every part of the machinery is in duplicate. It may be of interest here to note that the charge for incandescent lamps (16-caudle power) is to be raised shortly from $1 to $1.50 per lamp per month, the new rate to go into effect as the present contracts expire. The cause for this increase is just and proper—briefly summed up, it is that the lamps cannot be maintained at anything short of $1.50 without loss to the Company. When two competing electric companies appealed to the public for favor, the average rate during the competitive days was not less than $1.50, but when consolidation was effected the present Company thought it would be good policy to put the charge at $1 per lamp, in the belief that the increased patronage would counterbalance the decreased charge. Experience, however, has demonstrated the fact that incandescent electric lights of 16-candle power cannot be relied on to yield even a moderate profit, when supplied at a figure less than $1.50 per month. The gas works section of the business has not been neglected; in fact I may say that it is the Company's main hold. Superintendent Hammatt has a works fully up to delivering 300,000 cubic feet of gas per day, while the demand in winter is not at present much over 100,000 cubic feet. Hence it is fair to infer that Jacksonville need not fear for a shortage in its gas supply. The outlook for the coming winter season is very bright.—Yours.—T. U."

Miss Eliza A. Bates, second daughter of Mr. Thomas A. Bates, Superintendent of the Norfolk (Va.) City Gas Light Company's works, is now Mrs. John F. Small. Her husband is a popular young business man of Norfolk.

A writer in a recent issue of the New York *Press* asserts that there is some likelihood of the Standard Gas Company becoming a branch of the Consolidated Gas Company. We do not believe there is any truth whatever in the intimation.

We regret to say that Mr. Thomas B. Garland, Treasurer of the Dover (N. H.) Gas Light Company, and one of the leading business men of that place, was thrown from his carriage, on the afternoon of the 25th ult., sustaining severe injuries.

The Chelsea (Mass.) Gas Light Company is in the field with an announcement that on and after October 15th it will be in readiness to supply incandescent electric lights to its customers. The supply will be kept up through the 24 hours, and the rate is to be 1¼ cents per lamp per hour for each 16 candle lamp in service.

The Hutchinson (Kas.) Light, Heat and Power Company, which manufactures water gas, is experimenting with Colorado anthracite in its generators. So far the proprietors say the material has answered their every expectation, which must be taken as evidence that Hutchinson will no longer have to depend on Pennsylvania anthracite.

Mr. Walter S. Allen, Clerk of the Board of Gas and Electric Light Commission, gives notice that a public hearing will be had to-day in the meeting room of the Board of Selectmen, Rockland, Mass., on an appeal of the Rockland Electric Light and Power Company from the decision of the Selectmen granting permission to the Electric Light and Power Company, of Abington and Rockland, to set poles and run wires in the streets of the town of Rockland for the purpose of furnishing lights and power for public, mechanical, commercial and domestic uses to the residents of the town, etc.

The Directors of the Willimantic (Conn.) Gas Company are dickering for a consolidation of interests with the local Citizens Gas Light Company.

P. B. Echols, of Birmingham, Ala., acting as administrator of the estate of John Echols, has filed suit for $30,000 damages against the Birmingham Gas and Electric Light Company. He alleges that John Echols was killed by an electric current which passed from the line wire to the body of Echols through a "guy wire," and that the contact was made possible by the Company's negligence.

The Catskill (N. Y.) Illuminating and Power Company has been incorporated by Messrs. W. S. C. Wiley, Edwin Lampman, J. Atwater Cooke, A. M. Young, Fred. Werner, Jacob J. Werner and Stanley Vincent. The capital stock is $45,000, and the objects are "to manufacture, deal in and use dynamos, lamps, motors and storage batteries, and generally to supply electricity for lights, power and other uses to the inhabitants of Catskill and Greene counties."

We are told that the Selectmen of Watertown (Mass.) recently held a hearing for the purpose of receiving complaints from residents who claimed that the public electric lighting service from the Newton and Watertown Company, who are under contract to perform the work, was inefficient. Less than a dozen of the complainants appeared, and their testimony was chiefly of the hearsay order. Messrs. Waldo Learned and Wells Holmes, of the Company, were present, and testified that their service was fully up to the standard of the contract. The Selectmen seemed to think that the Company had the better of the argument, and refused to order a change to be made.

The Massachusetts Board of Gas and Electric Commission on September 27th gave a preliminary hearing, in the City Hall, Chelsea, on the petition of certain residents of the city that the Chelsea Gas Company be directed to reduce the price of its gas, and that it be required to keep up a continuous electric supply. After some testimony was presented, the Board adjourned the hearing to Tuesday, of this week.

The contract for laying the mains of the new Gas Company that is to distribute gas through the streets of New Utrecht, L. I., has been awarded to John J. Morrissy, of Bensonhurst, who agrees to complete the work on or before Jan. 1, 1891. The agreement calls for the placing of 25 miles of pipe diameters of same to vary from 16 inches to 3 inches. A separate plant will not be erected, save in respect to a holder, the gas to be taken from some one of the Brooklyn Companies—probably either from the Fulton-Municipal or the Citizens.

Mr. Nettleton is engaged on the work of overhauling the main system of his Company—the Derby Gas Company, Birmingham, Conn.

The following from the Philadelphia *Inquirer*, of the 27th ult., explains itself: "The United Gas Improvement Company has secured possession of the new Twenty fifth Ward gas plant, which has been operated for the city by the Philadelphia Gas Improvement Company. By this purchase P. A. B. Widener and William L. Elkins become full-fledged members of the U. G. I. Co. The suits for infringement against the Philadelphia Company fall, and the two interests will hereafter work as one. The United Gas Improvement Company set on foot not long ago a scheme to secure many of the big Gas Companies in the country. They proposed an American Gas Investment Company, with $50,000,000 capital, which it was intended should embrace many foreign investors. The scheme, however, fell through. Then the United Company authorized another issue of $5,000,000 worth of stock, making its capital $10,000,000. Of the extra issue $1,250,000 was used in the purchase of gas works, taking in the new Twenty-fifth Ward plant, which was controlled by Messrs. Widener and Elkins. This has brought these two capitalists into considerable prominence in the management of the United Company's affairs, having recently been taken into the Board of Directors. The change of control in the Twenty-fifth Ward plant will not in any way affect the contract with the city. Besides this purchase the Company already owns many works in different sections of the country, and others will be secured. The stock of the United Gas Improvement Company is selling at about $100 per share, its par being $50. Eight per cent. dividends have been declared, although the Company claims to have been making 15 per cent. profits. Respecting the new deal the Company has issued this circular to its stockholders: 'We desire to advise you that the Company has acquired the more important properties upon which options had been secured for the proposed American Gas Investment Company, and will make payment therefor with its own stock at the rate of $100 per share. The purchase of these properties was made after very careful examination by our experts, and upon a basis which will materially add to the earning capacity of the Company. The amount of stock of the Company at present issued is about 100,000 shares, par value $50 each. About 250,000 shares will be required to complete the above transaction, leaving about 75,000 shares unissued of the capital stock now authorized. At a meeting of the Board, held this day (Sept. 25) it was de-

termined to allot the remaining 75,000 shares to the stockholders of record on the date of allotment for cash at par, viz., $50 per share, and to call payments thereon in 13 monthly instalments, to be paid on the first day of each month, beginning November 1, 1890, the first instalment to be $2 per share, and the remaining instalments $4 per share each Interest at the rate of 6 per cent. per annum will be allowed on all instalments paid. Notice of allotment and a form for subscription will be mailed to the stockholders of record on the date of allotment. In consequence of the action announced above the organization of the proposed American Gas Investment Company will not be proceeded with, and therefore the usual October dividend will be paid upon the present capital stock of the Company. The circular is signed by Wm. W. Gibbs, Geo. Philler, Thos. Dolan, Wm. G. Worden, Henry C. Gibson, Wm. L. Elkins and P. A. B Widener."

THE new plant of the Grand Rapids (Mich.) Gas Company will be in readiness for operation on November 15th—so the contractors say.

JUDGE BARR, in the United States Circuit Court, for the Louisville (Ky.) district, on the afternoon of the 23d ult., in the case of J. B. Pace, of Richmond, Va., against the Kentucky Rock Gas Company, granted the prayer of the petitioner for a receiver, and, by agreement of counsel, Mr. Donald MacDonald, of Louisville, was appointed to the position. Mr Pace, in his petition, does not charge fraud upon the part of any of the stockholders or owners of the Kentucky Rock Gas Company, but he does allege that its affairs have not been intelligently managed.

AT a meeting of the stockholders of the Worcester (Mass.) Electric Light Company, the meeting having been called for the purpose of taking action on the proposed consolidation of its property and interests with those of the local gas company, the proprietors of the latter having already assented to the proposition, 1,363 shares of stock were represented. A motion was offered by Stephen Salisbury that the Company should sell its plant on such terms as had been agreed upon by the committee appointed from the Companies, and it was unanimously adopted. As a majority vote only was necessary, and as the capital stock is divided into 2,000 shares, the 1,363 assenting shares were more than ample. The remaining step necessary to complete the transaction is the approval of the Board of Gas and Electric Light Commission, and this body will hear the application on the 9th inst. If all goes well the two Companies will be consolidated, and each shareholder will receive stock in the new corporation, share for share.

MANAGER PERRY, of the Bath (Me.) Gas Light Company, has resigned that position.

SUPT. DANIELS, of the Columbia (S. C.) Gas Company, is to be congratulated on the promptitude with which he restored the works to a gas making condition, following the conflagration at that plant something over a fortnight ago. The loss to the Company is put at about $2,500.

THE Fort Wayne Electric Company is now making a four-ampere arc dynamo of the Wood pattern, and sales of the same have been made to the Aurora (Ind.) Gas Light and Coke Company, and to the Charleston (West Va.) Gas Company. Both of these plants are to be run by gas engines. This apparatus would seem to be peculiarly well adapted for operation by gas companies in small works, as the Fort Wayne Company guarantees that three arc lights can be obtained from each horse power afforded by a gas engine.

BY the way, it is only proper to state in connection with the above sales that they resulted from the labors of Mr. C. S. Knight, than whom the Fort Wayne Company has no more popular representative.

THE East End Electric Light Company, of Pittsburgh, Pa., will add 5,000 incandescent lamps to its present service, the additional equipment to be in working order on or before January 15th. This will enable the Company to maintain 25,000 lamps.

ON September 26th, Patrick Dunn, of Philadelphia, brought suit in the Common Pleas Court to recover damages in the sum of $15,000 for injuries to his minor son, Charles Dunn. He alleges that the lad, who is 13 years of age, tripped and fell over a gas cut-off box, located on the west side of Belmont avenue, and sustained a fracture of the arm and other injuries. The claim against the city is based upon the allegation that it was its duty to have the box sunk sufficiently in the pavement so as to make the sidewalk safe for pedestrians, but as in this case the box projected above the level of the pavement some three inches, hence the complaint and claim.

THE Connelly Motor Company informs us that its motor run on the Halstead street line, Chicago, has been completed, and that Mr. Holmes, President of the railway company, has given the Connelly Company an order to equip the line. The two motors that were run over the Halstead street line have been shipped east to make other runs in cities anxious to test the merits of the Connelly system.

THE Boston offices of the Maryland Meter and Manufacturing Company have been removed from No. 4 Central street, to No. 92 Water street, Rooms 21 and 22.

SINCE the absorption of the Lincoln (Neb.) Electric Light Company by the local Gas Company, the joint proprietors have issued a notice that from and after the 15th inst. the rates for incandescent electric lighting will be reduced 15 per cent.

ADAM RIEHL, President of the San Jose (Cal.) Light and Power Company, gives notice that a meeting of the stockholders is called for November 17th, for the purpose of determining whether a bonded indebtedness of $60,000 will be incurred, the proceeds of the issue to be devoted to improving the Company's facilities "and enlarging its capacity for manufacturing gas, electric light, etc."

THE quarterly dividend of 2 per cent. on the capital stock of the Roanoke (Va.) Gas and Water Company, is payable now at the office of the Company in Phi'adelphia.

THE following shows the change in gas rates recently ordered by the Emlenton (Pa.) Gas Light and Fuel Company, which supplies natural gas :

OLD RATES.		NEW RATES.	
Winter.		*Winter.*	
Cook stove...	$2.00	Cook stove.....	$2.25
Sitting room.	1.75	Sitting room....	2.50
2d stove	1.50	2d stove	2.00
	$5.25		$6.75
Summer.		*Summer.*	
Cook stove...	1.50	Cook stove.....	2.00
Sitting room.	50	Sitting room free	0.00
	$2.00		$2.00

WE are indebted to Messrs. Bartlett, Hayward & Co., of Baltimore, for 4 beautifully finished photographs of the holder constructed by them for the Consolidated Gas Company, of this city, at its 63d street station. The pictures and their framing are in the best styles of such work, and they now hold the pride of place in our collection. One view shows the holder inflated, while the other reveals the guide-framing, etc., and both are models of clearness and realism. The dimensions of the holder, which is of the triple-lift order, are : Inner section, 180 ft. by 40 ft. 6 inches ; middle section, 182 ft. by 40 ft.; outer section, 184 ft. by 39 ft. 6 inches ; tank, 187 ft. by 41 ft. 6 ins. The capacity of the vessel is 3,035,000 cubic ft., or somewhat less than that of the Consolidated Company's holder on Avenue C, between E. 15th and 16th streets, which is rated at 3,300,000 cubic ft. We return our thanks to Messrs. Bartlett, Hayward & Co. for their courtesy, and congratulate them upon the artistic merit of their gift.

ON Tuesday last, Judge Lemmon, in the Court of Common Pleas, of Toledo, rendered a decision which is of importance to gas suppliers. Briefly stated, the facts are these : In the fall of 1886 the Northwestern Natural Gas Company applied to and obtained from the City Council, of Toledo, O., the right to distribute natural gas in that city at certain fixed rates, the same to be binding for a period to terminate July 1st, 1890. It was also agreed upon that rates thereafter should be adjusted by the Council and Company on mutual conference, etc. In March, 1887, the State Legislature passed an Act empowering City Councils to say at what price natural gas should be sold in their respective cities. On August 4, 1890, the City Council of Toledo, by ordinance, fixed the price at a rate that the Company refused to accept. The City Solicitor then obtained a temporary injunction restraining the Company from supplying gas at any higher than the ordinance rates, and applied for a mandatory injunction to compel it to furnish gas at the ordinance rates. The case was argued at length, and Judge Lemmon decided against the city on the ground that the original order of 1886, and its acceptance by the Company, was of the nature of a contract, and the subsequent law could not impair the obligation of that contract, under the Federal Constitution, and that if the rates are deemed too high, a court must pass upon the question, and not the City Council.

THE founders of Spokane Falls, Wash., having induced capitalists to invest their money in various enterprises in that city, are now disposed to keep other capitalists out, and to hamper those already on the ground. For instance, the proprietors of the Spokane Gas Light Company were not so long ago received with open arms, when they proposed to put their money in a lighting plant, and not only were the arms held open, but it was stoutly asserted that the embracing attitude would never be relaxed. It seems, however, that embracery would better express the existing attitude of the city authorities to the Company, in that the assessors have raised the valuation for taxation of the Company's belongings from $16,000 to $51,000. The injustice of the decision is shown from the fact that, between the times of valuation, the Company had expended but $1,000 on the works, etc., in the line of additions.

CAPTAIN W. H. WHITE, of this city, has secured a contract for the construction of a gasholder for the Pullman Palace Car Company, to be erected in connection with the Company's gas plant at Pullman, Ills. The Stacey Manufacturing Company, of Cincinnati, will furnish the iron work.

THE AMERICAN GAS LIGHT JOURNAL

MONDAY, OCTOBER 6, 1890.

The Market for Gas Securities.

Some further progress was made during the week on values of city gas shares, Consolidated having sold up to 98¼, the opening to-day having been made at 98¼. We have no doubt that 105 will be easily recorded in Consolidated before the holidays. Mutual is inquired after at an advance, and Equitable more than holds its own. Some of the wiseacres will have it that the days of the independence of the Standard Company are nearing an end, but we do not coincide therein. However, the preferred is notably stronger, having sold at auction (2 shares, only) during the week at 88. Brooklyn shares are rather weaker, save Citizens and Metropolitan, which more than hold their own. Other sales at auction were: 50 Fulton-Municipal, Brooklyn, at 136¾, and 200 Jersey City (N. J.), at 175. The situation at Chicago remains unchanged, and the general situation exhibits nothing noteworthy. Our item columns contain information of interest respecting the proposed increase in the scope of the United Gas Improvement Company.

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This gas can be furnished at a cost less per 1,000 cubic feet than the coal gas may be costing the company.

Our system is such that we can furnish plants that will carburet 50,000 cubic feet in 24 hours, or three or four million feet in the same length of time. *One* of our large benches or plants would be capable of generating 100,000 cubic feet of gas in 24 hours, which would raise the candle power on 2,000,000 feet (taking as a standard coal gas at 15 candles) 3 candles on the 2,000,000 feet, enabling the works to deliver to consumers an 18 candle gas; or, enlarging our plant, the candle power may be increased as desired, at the same cost per candle power, less interest on plant.

This is much less per candle power than it can be furnished by the use of cannel coal or by vaporizing naphtha. With our process we improve the whole output in color—viz., whiten the flame with the oxygen, as well as furnishing a *thoroughly fixed* gas, and no possible danger of separation as there is with vapor.

Correspondence solicited.

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Will be Held at Savannah, Oct. 15, 16, and 17.

HEADQUARTERS AT THE DE SOTO.

Parties wishing to join the Association must send in their application at least ten days prior to the meeting. Parties engaged in business relating to the Gas Industry are eligible as Associate Members. Application blanks may be obtained of the Secretary, C. J. R. HUMPHREYS, Lawrence, Mass.

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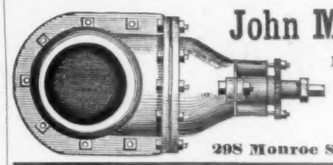

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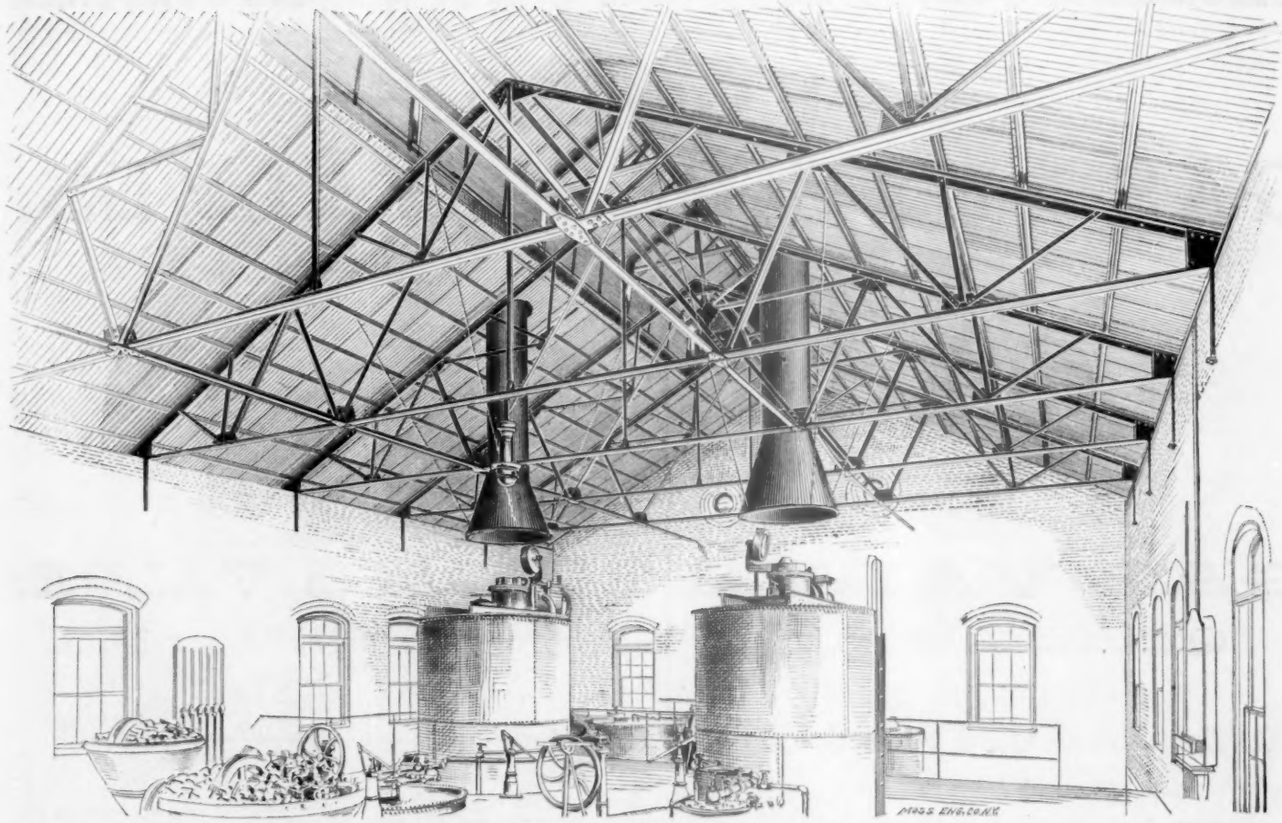

The above illustration is taken direct from a photograph of an iron roof built by us for the Providence Gas Company, at Providence, R. I. The roof is built entirely of iron—iron trusses, iron purlins, covered with corrugated iron. There is not a particle of woodwork anywhere about the roof, thus making it absolutely fireproof. Notice that along the peak of the roof there is a corrugated iron ventilator, with iron shutters opening and closing by cords from the floor, thus securing perfect ventilation. *Write for Illustrated Catalogue.*

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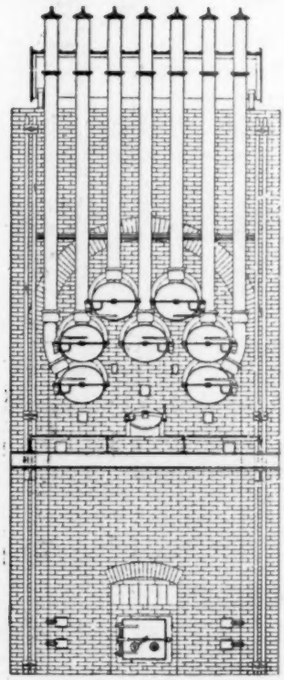

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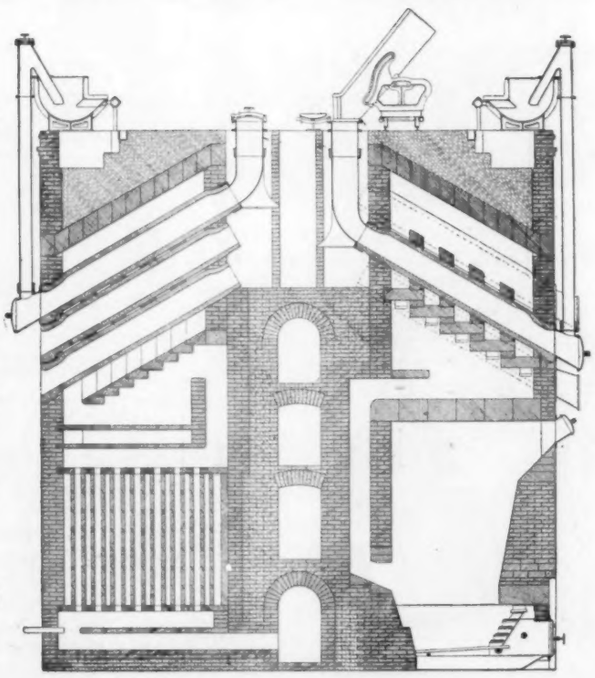

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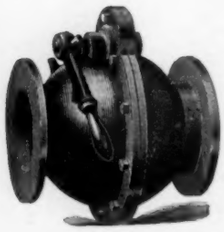

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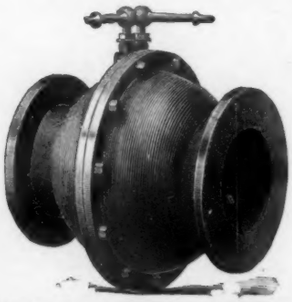

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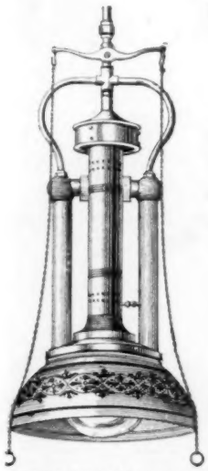

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A successful Competitor of the Arc Electric Light for lighting Store Fronts, Show Windows, Depots, Railway Sheds, etc., etc.

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Incandescent Gas Lighting.

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At the Fall Session of the Board of Supervisors of Winnebago County, held at the County Court House, Oshkosh, Wis., Nov. 26, 1889, the report submitted by Mr. C. W. Cook, Chairman of the Committee on Public Buildings, recommending the use of the Welsbach Incandescent Gas Burner in the Buildings under their charge, was unanimously adopted, because of the extreme economy in the consumption of Gas and the superior character of the light obtained.

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GOVERNOR BURNERS for STREET LAMPS AND GENERAL USE, and GOVERNORS FOR ARGAND AND OTHER COMMON GAS BURNERS IN ALL SIZES.

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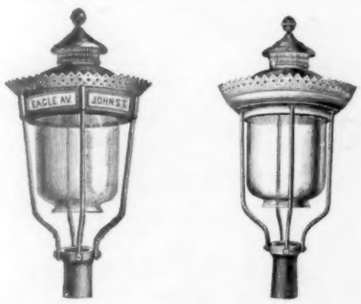

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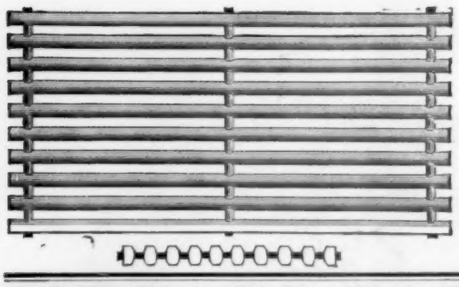

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Experimental Meters of all Kinds,

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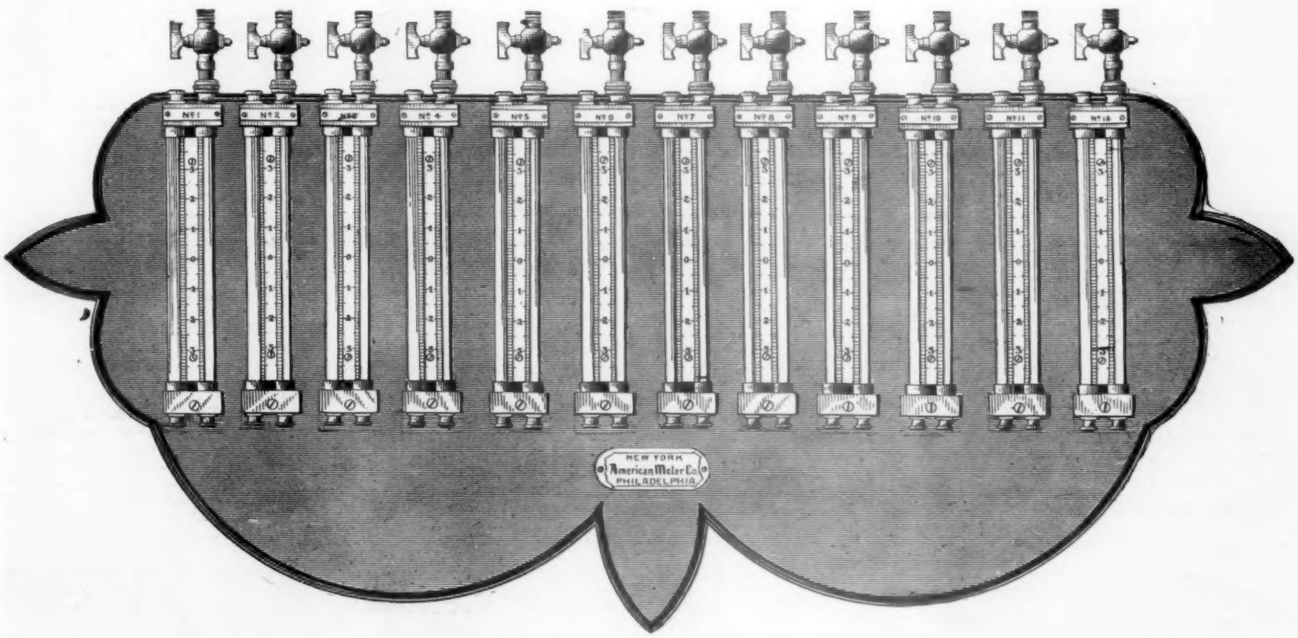

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PATENT "STANDARD" WASHER-SCRUBBERS

Erected and in course of construction at present date:

	Capacity. Cubic feet per day.
Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
" **Citizen**	500,000
Brookline, U.S.A.	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S.A	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A	1,000,000
"	1,000,000
" **Nassau**	1,000,000
Brunner, Mond & Co	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A	350,000
Denver, "	500,000
" "	1,000,000
Dusselldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A	1,000,000
Ilkeston	300,000
Inverness	200,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	500,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A	430,000
Newmarket	150,000
Newark, U.S.A	680,000
Northfleet	200,000
New York, U.S.A	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S A	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A	750,000
Yeadon	500,000
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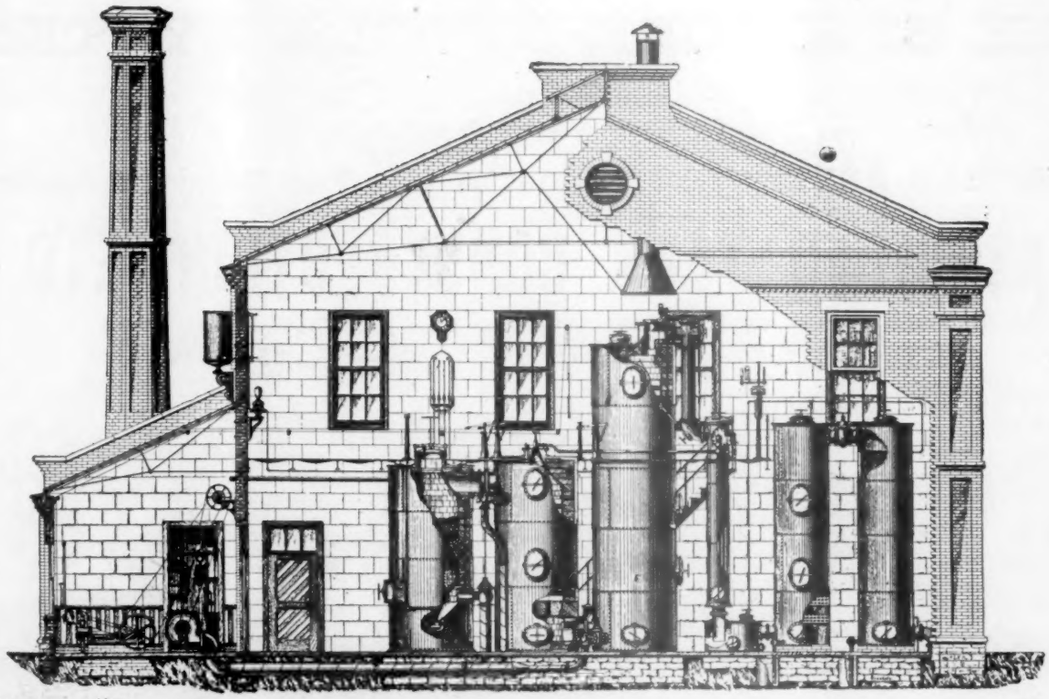

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USING LIMA OR OTHER LOW GRADE OILS AND ANTHRACITE COAL OR GAS HOUSE OR OVEN COKE.

PAMPHLETS, PLANS, AND ESTIMATES FURNISHED UPON APPLICATION.

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The total capacity of Springer Apparatus now in use is over 25,000,000 ft. daily.

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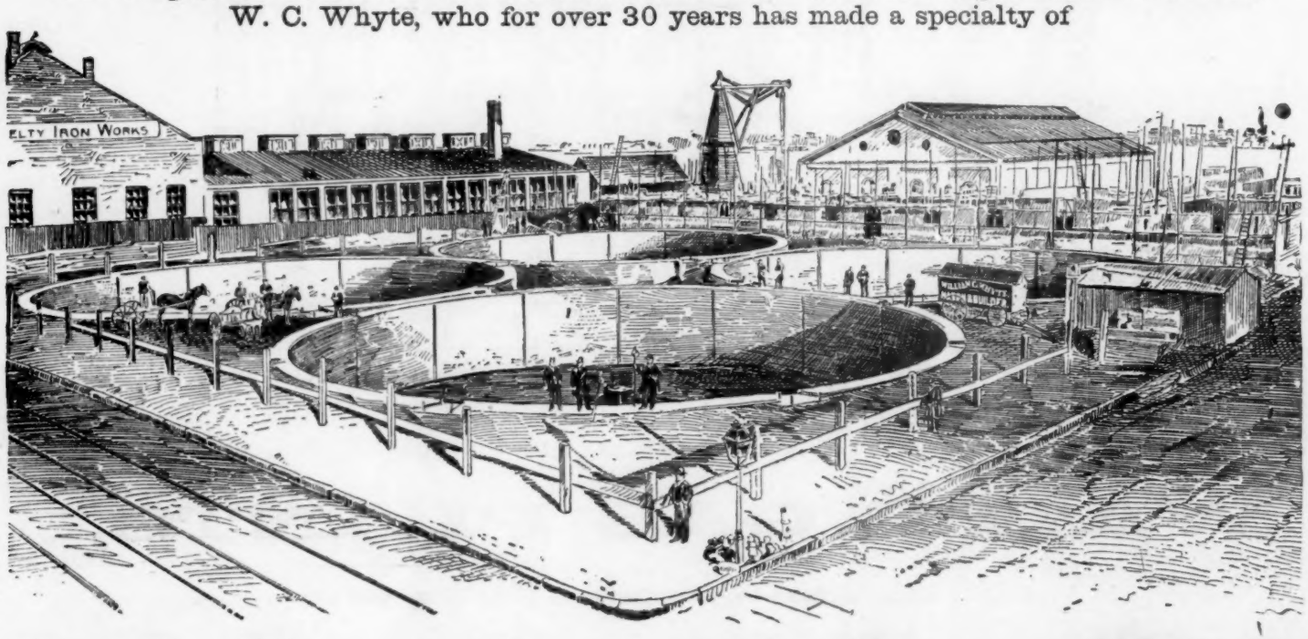

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AUTOMATIC GOVERNOR. Has been on the market but *three years*, and in that time has been introduced *more generally* than any invention ever designed for use in gas works. Over *two hundred* of them now in use. Sensitive; reliable; perfectly automatic; reduces leakage; satisfies consumers, and gives great relief to the Manager. No gas works is *complete* without one of these machines.

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The Best Governor in the Market for Rotary or Steam Jet Exhausters.

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BAKER ROTARY PRESSURE BLOWERS,

And Rotary Piston Pumps.

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Gasholder Tanks & Gas Works Masonry Complete.

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A Large Quantity of Ground Fire Brick For Sale Cheap.

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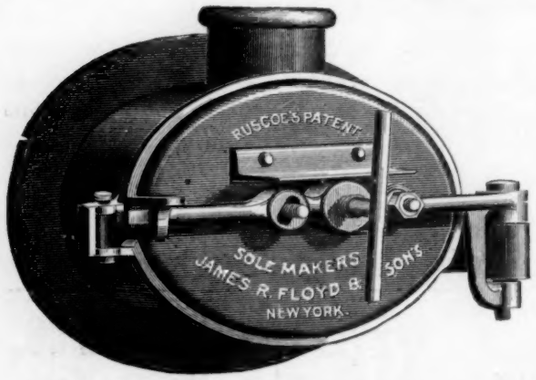

This Lid and Fastener is specially designed for taking up the wear and tear caused by refacing the Mouthpiece and Lid, hitherto in a large measure overlooked; and, in addition, from the special way in which the Lid is attached to the Cross-bar, the Lid has free action, and thus secures a more uniform scrape over the whole surface when being forced home by the Screw, the closing pressure being much more equally distributed than in any other form of fastening.

The Lid itself is well ribbed, internally and externally, thus securing the tightest, strongest, and simplest Lid in the market, and the most easily adapted to existing Mouthpieces.

The Cross-bar being of Malleable Iron, it is not liable to be strained, and there is no Eccentric to wear and become inoperative.

Made for Round, Oval, and D-Retorts to any required dimension. Patented in England and the United States by JOHN RUSCOE, Hyde, England, and used extensively in the London and other English Gas Works.

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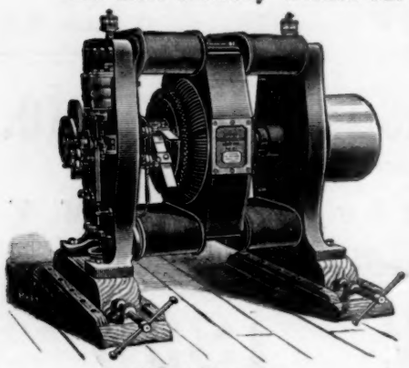

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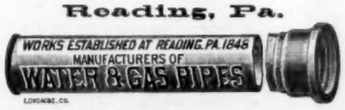

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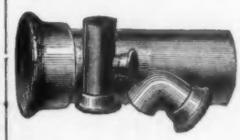

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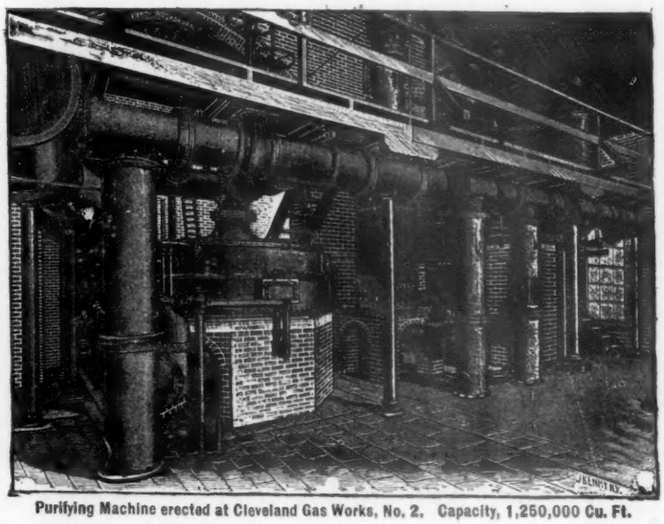

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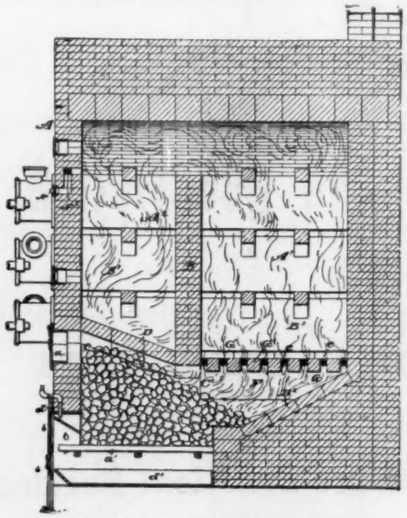

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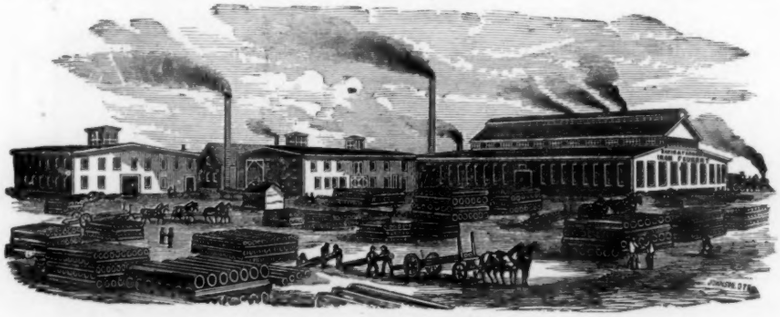

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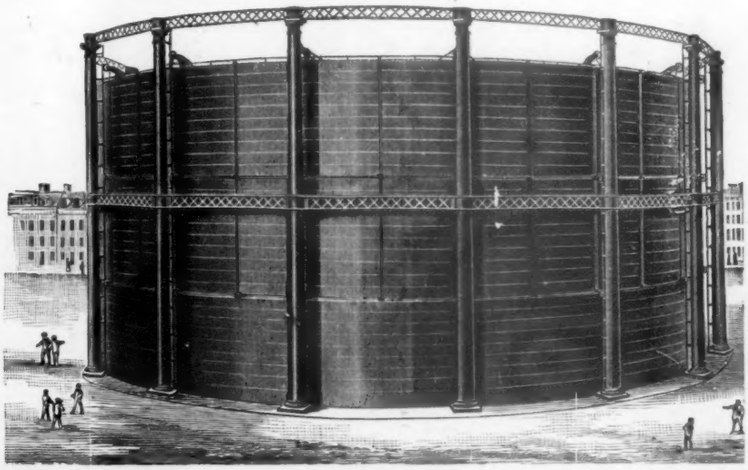

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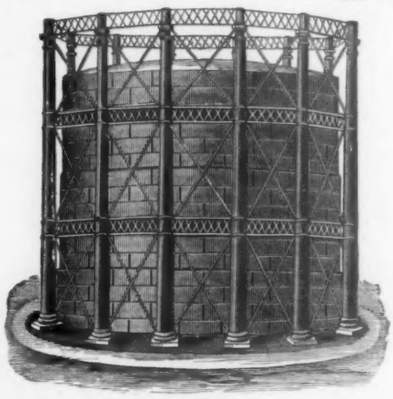

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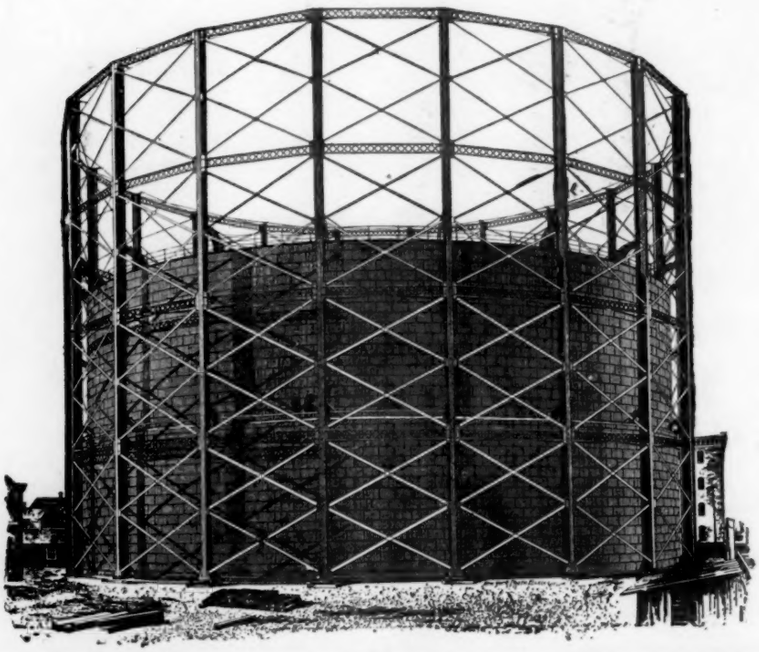

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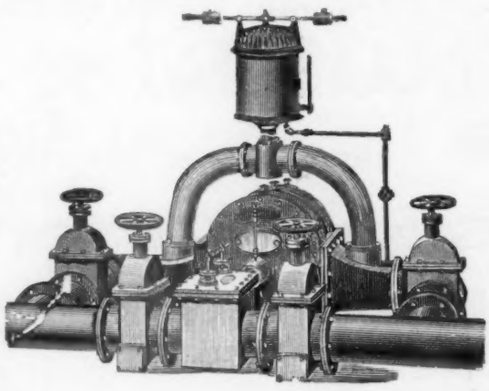

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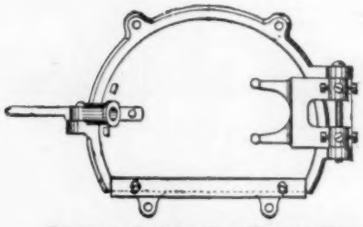

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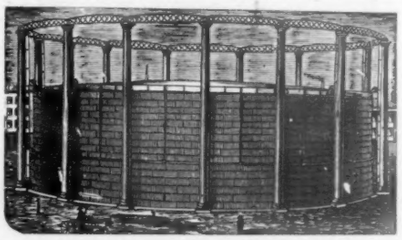
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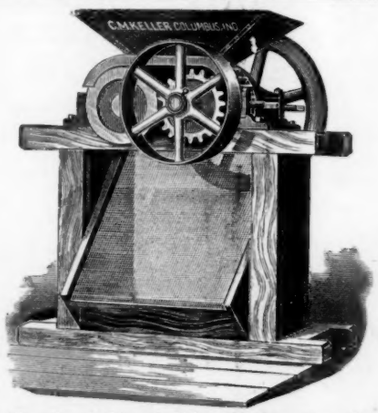

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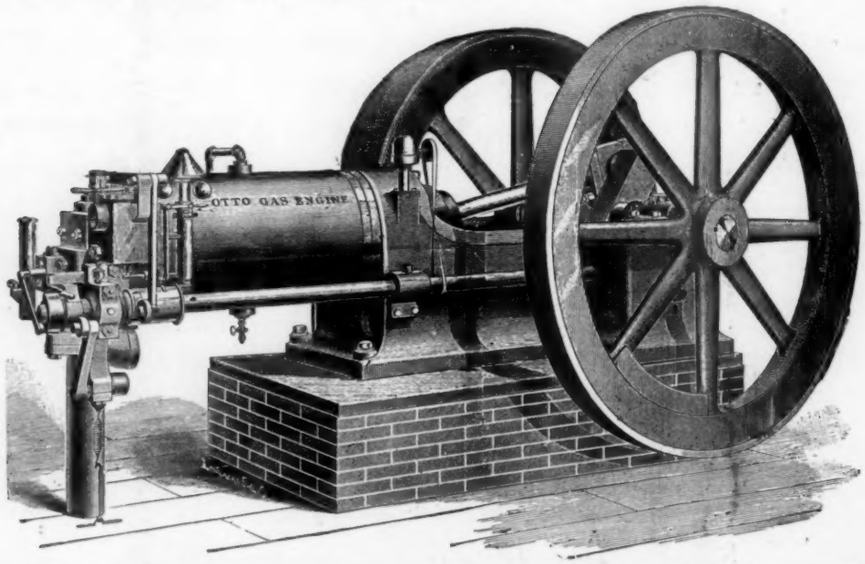

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